THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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THE PRESENT POSITION OF ELECTRICAL MANUFACTURING.

ON another page of this issue will be found a report of the annual meeting of Messrs. Crompton & Co., Ltd., of Chelmsford, and we are tempted to draw particular attention thereto, because we have ample reasons for believing that the difficulties which Mr. John Trotter there enumerates are confronting the major portion of the manufacturing branch of the British electrical industry at the present moment. No matter how up-to-date and enterprising may have been the steps taken during recent years to produce electrical machinery and material more cheaply, or to attain greater efficiency in the operation of manufacturing plant, the manufacturer is persistently kept in mind of the painful fact that there is such a struggle going on between himself and his rivals to secure any new business there may be going, that the margin of profit will be very meagre indeed, even if any margin exist at all. The efforts at modernising and economy are rendered nugatory by an unprecedented competition, which it is pretty safe to say cannot continue without some more serious results than the mere reduction of dividends.

There are various theories for the present weak state of our industry, and doubtless they are all in a measure correct: a cycle of bad trade; the tightness of money; the difficulty experienced by municipalities in obtaining capital for extending their electrical systems; the dumping methods of the foreigner; the desire of American-English factories to sweep out of the way some of their competitors; the establishment of enormous works to meet an uninterruptedly increasing demand for electrical machinery which was anticipated, but which has not been experienced—and so on.

To put it briefly, the works' capacity of the United Kingdom would seem to be at present in excess of the requirements of the market, and if these factories are to be kept operating, and their large staff fully employed, work must be obtained at any price. That, so far as we can gauge it from statements which reach our ears from different directions, is the attitude of many—of course, there may be some fortunate exceptions—electrical firms. The obvious effect of this is that unless a speedy improvement in trade be brought about, only those concerns which occupy a position of strength can survive; the weaker ones, as Mr. Trotter puts it, will be "cleared out," leaving "some room for the stronger ones that remain."

It is satisfactory to find that shareholders in electrical companies seem to have a correct appreciation of the present position, for although the Crompton dividend is at the rate of only 2½ per cent. per annum, instead of the 6 per cent. declared last year, and this drop comes a short time after reconstruction and writing down of capital—in spite of these things, there was not a complaining voice from the shareholders' side of the table. The passing of the interim divi-

dend had, doubtless, prepared them for a less successful year, and they had resigned themselves to whatever might come to them when the final account was presented. Mr. Trotter struck a good note when he told of the new and more energetic steps which were being taken to bring in fresh business, but he also hinted that this new business will not be expected in municipal works, where prices are being cut most drastically because of the competition. The company is looking to its own affiliated companies, one of which has only lately been floated, for work rather than to an open market, very much on the same lines as the Brush Co. adopts by supplying material to the systems of the B.E.T. Co. This may be a temporary measure for obtaining orders for the factory until the present unsatisfactory state of things has passed.

There are electrical manufacturers whose position is far less happy than that of the Arc Works, but we need not here single any of them out for reference. There is always a good deal of conversation going on between electrical men as to the position of so-and-so and so-and-so, and much of it may be true, but a good deal of it only imaginary. The manufacturing reports which have appeared in the "City Notes" of the ELECTRICAL REVIEW during, say, the past six months, and the general trade matters recorded in our "Business Notice" columns from week to week, are well worthy of close study at such a time as this.

Many are asking how long business will remain stagnant. Our own view is that there is no need for anything like despair; the present stage is only a passing one; but there may be the weeding out of a few concerns here and there before all is well again.

The B.A. Meeting at Cambridge.

BEFORE our next issue appears, the annual meeting of the British Association for the Advancement of Science will have been opened at Cambridge. Mr. Balfour is to deliver his presidential address on Wednesday evening next. The time has passed by when electrical engineers expected papers of startling practical consequence to be read before a B.A. meeting, and it is generally only during the delivery of the sectional address that the audience in "G" musters many in excess of a score, and some of these only look in to know what is going on, and leave after they have taken a nibble. The papers on "The Internal Combustion Motor in Britain," by Mr. C. Dugald Clark, and on "Some Tests on Small Gas Engines," by Prof. B. Hopkinson, are expected to produce a joint discussion, which ought to be good if the right men are present to take part in it. Monday, August 22nd, will doubtless find more electrical men there than will attend at any other time during the meeting, for the papers set down for that day are all within their province. The North-Eastern electrification, a subject which we are all following so keenly at the present time, is to be brought up by Mr. C. H. Merz, the consulting engineer responsible for the supervision of the work, and we trust he will have something that is not already common knowledge to tell us on the matter. "Electricity from Water-Power" will occupy Mr. A. A. Campbell Swinton; Messrs. W. M. Mordey and A. G. Hansard will discuss "Energy Losses in Magnetising Iron"; and Prof. J. A. Fleming has a paper on "Large Bulb Incandescent Lamps as Secondary Standards of Light." These four papers should provide at least a good morning's work for the section.

The president of the Engineering Section is the Hon. C. A. Parsons, F.R.S., so we may, of course, expect to hear something further on the subject which of recent years has made his name so famous. In *Nature's* usual forecast we find nothing to lead us to believe that the Mathematical and Physical Science Section (A) will be strong electrically. There will be a discussion on the radio-activity of ordinary matter, which Prof. J. J. Thomson is to introduce; a communication by Prof. Larmor on the laws of radiation; an address by Prof. J. A. Fleming on recent advances in connection with wireless telegraphy; and an account by Dr. Glazebrook of some recent work at the National Physical Laboratory.

Electro-Peat-Coal.

WE, with other Press representatives, were refused admission to the statutory meeting of the Electro-Peat-Coal Co. on Tuesday; the *Financial Times*, however, though among the number excluded, has succeeded in securing a report of what transpired. If Mr. Scoones, M.I.C.E., is correctly reported in our contemporary, he makes confusion worse confounded. He says that when the discrepancy between a pound and a kilogramme was first brought to his notice, he thought a serious mistake had been committed. He had, therefore, gone most carefully into the matter, and recent investigations of his showed "that it was still possible to regard peat-coal as having, on the average, a calorific value of 13,000 units." But this is per kilogramme, not per pound; reduced to pounds it means just below 6,000 units per pound; while the best Lancashire coal, from an average of 24 samples, gives 13,963 units. "It held the heat a good deal longer than ordinary coal," he said, "and though he had never pretended to compare it with ordinary coal, he was convinced that it was a good commercial article." This may be magnificent, but it is not engineering!

Again, "from tests which he had had made, he found that equal quantities of best Lancashire coal and peat-coal would evaporate in the same time 7 and $8\frac{3}{4}$ lbs. of water respectively, which was an excellent proof of the value of their product." It would be interesting to learn who was responsible for this remarkable result, for whereas in a test made on a boiler fired with peat the evaporation was only 4·2 lbs. of water per lb. of peat, the best Lancashire steam coal would evaporate in a good boiler 10 to 11 lbs. of water. Peat is very bulky, and occupies about four times the space for equal weights of coal, and as its *maximum* evaporative power is little more than one-half that of coal, about 8 cb. ft. are required to evaporate an equal quantity of water as 1 cb. ft. of coal.

Its *maximum* calorific power is about 7,440 units, and its *maximum* evaporative power about 7·7 lbs. of water from and at 212° F., but the evaporative power of peat of average quality is very much less than this, as will be seen from the result of the test given above.

The *Financial Times* considers that Mr. Scoones's confession, that the criticism to which his work has been subjected has led him to devote much more attention to peat-coal than he had previously done, somewhat discounts the value of his original report, and will hardly lead the shareholders to hope that his later assertions may not be open to revision. Perhaps our contemporary may find space to bring the foregoing to the notice of those same shareholders.

Engineering Standards.

As these pages go to press, we have received from Mr. L. S. Robertson, secretary of the Engineering Standards Committee, a copy of the interim report of the Sub-Committee on British Standards for Electrical Machinery. Standard pressures for direct and alternating current work have been adopted, and the standard frequency of 50 cycles per second for the latter, 25 cycles being allowed as a secondary standard. The rating of generators and motors, and other important matters, are included in the report, which, by the request of the Committee, we shall publish in full in our next issue.

NAVAL BOILERS COMMITTEE REPORT.

The Committee have now issued their final report on naval boilers, and they state on an early page that, since their report of May, 1902, they see no reason to modify the opinion therein expressed, that it is "undesirable to fit any more of this type in H.M. Navy," the words "this type" referring to the Belleville boiler. The sharpness of this sting is taken off somewhat by the introductory letter of Admiral Sir Compton Domville, the President of the Committee, who feels compelled to say that his Mediterranean experience has been favourable to the Belleville, and that the early Bellevilles were badly built and badly used. Having delivered himself of this quite reasonably flat contradiction of his colleagues on the Committee, he next proceeds to express his high opinion of the work of these same colleagues, and so this famous Committee goes out of action like a sepia, with the true issue confused in a cloud of civilly distributed ink.

In all, trials have been made on R.M.S. *Saxonia* and on H.M.S. *Hyacinth*, *Minerva*, *Seagull*, *Sheldrake*, *Espiègle*, *Fantôme*, *Medea*, *Medusa* and *Hermes*.

It will be remembered that in their earlier reports the Committee recommended trials to be made of four water-tube boilers—namely, the Babcock & Wilcox, Niclausse, Dürr and Yarrow large tube—and they now express their approval of the first and fourth of these boilers, the one with tubes nearly horizontal, the other with nearly vertical tubes; and they think the upkeep of these boilers, though in excess of the upkeep of cylinder boilers, will be a minimum for water-tube types. In this report, among other items, the thermal efficiencies of the boilers tested are given. The best, with the Babcock boilers of the *Hermes*, with vertical baffle plates and a forced air supply over the fires, was 81 per cent. on a 30-hours' trial with a coal consumption at the rate of 20 lb. per ft. of grate per hour. With 27 lb. of coal the efficiency fell to 77·8 per cent. These rates were those of ordinary steaming and full power respectively. Without special air over the fires, and burning 20·5 lb. of coal, the efficiency was 75·8 per cent. Other tests showed less efficiency when no air was specially forced in over the fires.

The Yarrow boilers of the *Medea* gave 75·7 per cent. efficiency on a 26-hours' run at 18 lb. of coal per hour per sq. ft. of grate. It was 69·5 per cent. when burning 40 lb. of coal. The Belleville boilers of the *Hyacinth* showed 77 per cent. efficiency, with 16 lb. of coal on a 24½-hours' run, and 73·3 per cent. with 20 lb. At full output, with 27 lb. of coal, the efficiency fell to 65 per cent.

The Dürr boiler, when burning 35 lb. of coal, gave 64·8 per cent. efficiency. At 16 lb. of coal, and in a 26-hours' run, the efficiency was only 63·8 per cent. The first trial was only for 8 hours, and the figures give room for some doubts as to their correctness, as they are inconsistent. The cylinder boilers of the *Saxonia* showed 82·3 per cent. efficiency with 20 lb. coal combustion, but the cylinder boilers of the *Minerva* only gave 69 7 per cent. on a 25-hours' trial at 14 lb. combustion rate. With retarders at 29 lb. per sq. ft., the figure only fell to 68·4 per cent. In the smaller ships the Babcock boiler, on 12-hours' tests at 18 lb. coal consumption, did not exceed 66 per cent. efficiency in the *Sheldrake*, and 73·2 per cent. at 13 lb. in the *Espiègle*, while the Niclausse boilers of the *Seagull* showed 66·9 per cent. efficiency at 13 lb., and those of the *Fantôme* 69·8 per cent. at 14 lb.

It is noted that the Babcock boiler has improved upon its earlier types, so that on one occasion on the *Hermes* even 81 per cent. efficiency was attained, but in the three sets of these boilers which were tried, the heating surface and baffles were differently arranged. Then the tubes of the *Sheldrake* were $1\frac{1}{16}$ diameter without baffles, those of the *Espiègle* $3\frac{3}{16}$ diameter with the vertical baffles usual in stationary boilers of this make, and the boilers of the *Hermes* have two rows of $3\frac{3}{16}$ tubes over the fire, the remainder being $1\frac{3}{16}$ only, and the baffling was effected simply by restricting the escape of the hot gases at the top rows. But those boilers of the *Hermes*, which showed 81 per cent. efficiency, although similar in construction to the last-mentioned, had vertical baffles and a forced air supply, which latter item seems to point out that the Babcock boiler would be seriously improved by such proper furnace arrangements as would gain for it more than the benefit shown by the forced air supply which is, after all, only a gas mixing device and a retarder of the gases from too rapid contact with the cold tubes.

Wetness of steam was tested by a Carpenter calorimeter. No doubt this instrument does register correctly the quality of the steam passed through it, but this is very different from saying that correct samples of steam were passed through it.

As regards loss of water, it is indicated in the report that multiplicity of doors implies loss of water, and the Yarrow boiler is commended in that it has few doors.

On the other hand, as regards ease of inspection and tube removal, the Niclausse boiler is condemned as inaccessible at the back end of the tubes, which can only be emptied by special means. The Dürr boiler, also, is troublesome, and both these boilers require too much space for tube removal, &c.

The Yarrow boiler is awarded the palm for facility of access and inspection. Nor can the Dürr and Niclausse tubes be cleaned externally so well, owing to the baffles, and, generally, the baffles render cleaning of the tubes externally somewhat difficult.

No surprise will be felt that flatly-inclined tubes bent considerably next the fire; nor that the Yarrow tubes are recommended to be put in with an initial bend of 1 in., to take up expansion.

Generally tubes have not corroded, and wear has been slight in all cases.

The Yarrow boiler stands at an advantage as regards its casings, in that the gases only touch the casings after passing through a bank of tubes. This applies, of course, to the side casings.

The Niclausse and Dürr boilers cannot, with safety to their tubes, be worked above 35 lb. of coal per hour per square foot of grate.

The Yarrow can be severely forced with safety. As regards stoking, it is admitted that special skill is required, especially on the large grates of the horizontal tube types of boiler. The Yarrow boiler showed good results with men new to the ship.

On the question of superheaters, the small-tube species seems to have been a failure, and it is stated they will require frequent renewals. The omission of automatic feed regulators is indicated as desirable. Salt water as feed did not show evil effects in the Dürr and Yarrow boilers tested in the *Medusa* and *Medea*. Finally, as regards weights per output, the best figure is 503 lb. of steam per ton per hour for the Dürr boilers of the *Medea*, 478 for the Yarrow boilers of the *Medea*, 410 for the Babcock boilers of the *Hermes*, and 394 for the Belleville's in the *Hyacinth*.

The *Minerva* gave 295 lb. for her cylindrical boilers. The *Saxonia* gave 132·6 only, but she is a Cunarder, and is not expected to lose time or money, and is run across the Atlantic as often as she can be driven.

The water-tube boilers of the Navy weigh one-half to one-third as much per unit, but whether they will fail at the critical moment, no one appears to know. Let us hope not. Thus ends the Boiler Committee and their work—a lame and impotent conclusion of divided counsel, the President contradicting the expressed opinion of his highly-esteemed colleagues. It was the Belleville that caused all the trouble, and ever since the Committee has been formed numerous rosy reports have appeared in favour of the same Belleville. Thus a ship steamed home from China at three-quarter speed, which sounds well to the general public, who do not realise that 3^3 is less than half of 4^3, and that halving the duty of a lot of boilers may mean all the difference between failure and success. It is difficult to get at the truth in naval affairs. Perhaps it is as well that this is so, nor would anyone complain did not the suspicion arise that more is known at Kiel of our naval affairs than by our own people. Engineers, after all, can only form their judgements from the probability of the case, and should, therefore, ask themselves as to the probabilities of a manifold tube 90 ft. long, laid over a fierce fire, being durable or safe, or likely to secure efficient movement of water and steam.

The principle of limited circulation followed in the Belleville boiler may be right—we believe it is right when

the tube is short and delivers in the steam drum above water-level, but it cannot be claimed as right where tubes of the immense length of the Belleville manifolds are employed. Careful working and gentle firing may make a success of the boiler at that rate of working, but the boiler for the Navy must be safe and efficient when the vessel is being forced at top speed, and in deadly earnest. At such a time there would be no gentle stoking; everything would be going hard, and no one would think of consequences.

It is certainly a cause for congratulation that the Babcock & Wilcox boilers, so well known to everybody in the electrical world, should have such special commendation bestowed upon them, and equally so that the Yarrow boiler comes in for similar praise. The former especially seems to have a new field for usefulness opened out for it, and we may be sure that every advantage will be taken of the Admiralty's certificate of fitness for our first line of defence.

RAWORTH'S TRACTION PATENTS.

On more than one occasion we have published descriptive articles of Raworth's traction patents, which consist of his demi-car and devices connected with automatic regenerative control. Only a fortnight ago, we referred to a very successful demonstration of these inventions on the Gravesend and Northfleet tramways, and now we are able to allude to them again at greater length.

The two demi-cars on which the experiments were made carry 20 passengers each, and were each fitted with two 28-H.P. motors. The main feature in Mr. Raworth's system of regenerative control is that the motors are compound wound, the series coils being used for emergency purposes only, while the shunt coils provide excitation for normal running. When running down hill, and at all times when under ordinary conditions brakes would be used, as when stopping, the motors act as generators, restoring power to the line. On all down grades the motors automatically control the speed without waste of energy, as it is impossible for them to run faster than a certain speed.

The larger cars on this line, which are worked with series-parallel control, employ two motors of 25 H.P. each, and carry 46 passengers.

It will be understood that as the motors used for automatic regenerative control are always either receiving current from or giving current to the line, they have to be somewhat larger than those employed on the series-parallel system, but it must not be supposed that the demi-cars, which weigh about $5\frac{3}{4}$ tons, as against the $8\frac{3}{4}$ tons of the other type, and carry less than half the complement of passengers accommodated on the latter, require such large motors as were employed on the occasion of the demonstration. Motors of less than 28 H.P., suitable for Mr. Raworth's purpose, could not be obtained in the market, so it was a case of Hobson's choice!

But even if the demi-cars have necessarily to carry motors which, in comparison with the respective weights of the regenerative and series-parallel cars, seem unduly large, the saving in electrical energy justifies the increased price, which, after all, enters only into the first cost of the car.

Exactly how the cost of upkeep of the regenerative system compares with that of the series-parallel method, we have, so far, no means of determining with any degree of accuracy, but that it is materially less will be gathered from what is said further on.

The units per car-mile taken by the series-parallel controlled cars came out at 0·97, while the demi-cars used 0·38.

As we have said in one of our previous articles, the demi-car was designed for use on lines which, at certain hours, cannot support the higher working expenses of a full-sized car; in other words, for converting what would otherwise be a loss into a profit. The construction of the cars was described and illustrated in our issue of September 25th, 1903, and in a later number (February 26th, 1904) we published an article on the financial results to be obtained as between ordinary and demi-cars, in which we came to the conclusion that the advent of the latter ought to give a great impetus to the development of electric tramways, both by improving dividends and by making tramways possible in districts which under hitherto existing conditions would be unable to support them.

The following tests for the purpose of comparing the two systems were made by Mr. Sudworth, inspecting engineer to the British Electric Traction Co.:—

THE GRAVESEND AND NORTHFLEET ELECTRIC TRAMWAYS, LTD.

Test on a Series-Parallel Car, No 17, fitted with two Walker No. 33 N Motors, 25 H P, on the "Pelham Arms" and "Leather Bottle" Section of Line.

July 22nd, 1904. S. SUDWORTH.

Direction of run.	Distance in miles.	Time on trip.	Stops made.	Readings B.T.H. energy meter.	B. of T. units per car-mile.	Readings on Vulcan KW.-meter.	B. of T. units per car-mile.
"Pelham Arms"	...	...	...	14745	...	06520	...
to							
"Leather Bottle."	...	...	...	14800	...	06531	...
Return to							
"Pelham Arms."	1·9	13	5	14820	·8	06535	·8
Maximum amperes, 92.							
Repeat test—							
"Pelham Arms"	...	...	...	14820	...	06535	...
to							
"Leather Bottle."	...	...	...	14870	...	06546	...
Return to							
"Pelham Arms."	1·9	14	5	14895	·8	06550	·8
Maximum amperes, 85.							

Maximum current on railway bridge.

Tests on a Single-Truck Car, No. 17, Series-Parallel System on the Main Line—Denton and Swanscombe and Back.

July 23rd, 1904. S. SUDWORTH.

Direction of run.	Distance in miles.	Time on trip.	Stops made.	Readings B.T.H. energy meter.	B.O.T. units per car-mile.	Readings on Vulcan KW. meter.	B. of T. units per car-mile.
Denton Terminus	...	...	...	05220	...	06612	...
to							
Swanscombe Cross...	4	32	18	05405	·93	06649	·9
Total units used			...	37	...	37	...
Maximum amperes			...	95	...	...	...
Return Trip—							
Swanscombe Cross	...	...	...	05405	...	06649	...
to							
Denton Terminus ...	4	34	17	05597	96	06687	·96
Total units used return trip			...	38	...	38	...
Maximum amperes ...			...	110	...	...	...

Series-Parallel Test on a Double-deck Car, fitted with two Walker 33 Motors, 25 H.P. each, on the Windmill Street Section of Line.

July 22nd, 1904. S. SUDWORTH.

Direction of run.	Distance in miles.	Time on trip.	Stops made.	Readings B.T.H. energy meter.	B. of T. units per car-mile.	Readings on Vulcan KW. meter.	B. of T. units per car-mile.
The "Nelson"	...	...	...	14970	...	06665	...
to							
"Prince of Orange."	...	...	...	15020	...	06675	...
Return to the							
"Nelson."	1·56	9½	5	15045	·96	06680	·96
Maximum amperes, 85.							
Repeat test—							
The "Nelson"	...	...	...	15045	...	06680	...
to							
"Prince of Orange"	...	...	...	15090	...	06694	...
Return to the							
"Nelson."	1·56	8½	4	15120	·96	06694	·9
Maximum amperes, 88.							

The maximum amperes noted on Trip No. 1 was 85.
The maximum amperes noted on Trip No. 2 was 88.

Tests of a Regenerative Car, No. 10, *on the "Pelham Arms" and "Leather Bottle" Section of Line.*

July 20*th*, 1904. S SUDWORTH.

Direction of run.	Distance in miles.	Time on trip.	Stops made.	Readings B.T.H. energy meter.	B. of T. units per car-mile.	Readings on Vulcan KW.-meter.	B. of T. units per car-mile.
"Pelham Arms" to	...	...	...	14500	...	06480	...
"Leather Bottle." Return to	...	...	...	14532	...	06485	...
"Pelham Arms."	1·9	14	6	14545	·42	06487	·37
	Maximum amperes, 65.						
Repeat test— "Pelham Arms" to	...	...	...	14545	...	06487	...
"Leather Bottle." Return to	...	...	...	14580	...	06492	...
"Pelham Arms."	1·9	12½	6	14590	·42	06494	·37
	Maximum amperes, 60.						

The maximum current noted was 65 amperes on a gradient of 1 in 18 on the South-Eastern and Chatham Railway Bridge near depôt.

Tests on a Regenerative Car (One-Man Type) fitted with two Brush 1,202 *Motors.* 28 *H.P., on the Main Line between Denton and Swanscombe Cross and Back.*

Direction of run.	Distance in miles.	Time on trip.	Stops made.	Readings B.T.H. energy meter.	B. of T. units per car-mile.	Readings on Vulcan KW. meter.	B. of T. units per car-mile.
"Leather Bottle" ... to	...	...	...	13935	...	06386	...
Swanscombe Cross ...	...	...	...	13975	...	06399	...
Denton Terminus ... to	...	...	...	14085	...	06415	...
"Leather Bottle" ...	8	65	37	14140	·51	06424	·47
Total units used ...				41	...	38	...

Maximum current noted 65 amperes.

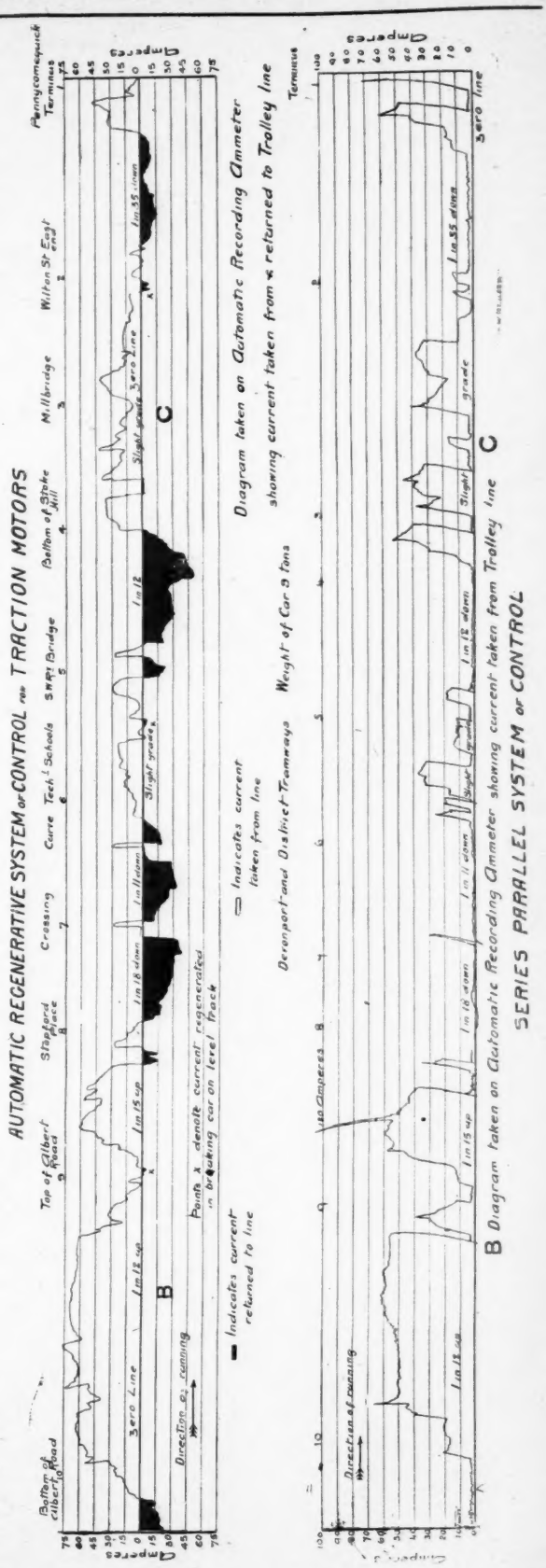
Tests on a regenerative Car (*No.* 9), *Single-deck, One-man Type, fitted with Two Brush Motors, No.* 1,202, 28 *H.P., on the Windmill Street Section of Line.*

Direction of run.	Distance in miles.	Time on trip.	Stops made.	Readings B.T.H. energy meter.	B. of T. units per car-mile.	Readings on Vulcan KW.-meter.	B. of T. units per car-mile.
The "Nelson" to	...	...	...	14625	...	06501	...
"Prince of Orange." Return to the	...	...	...	14655	...	06507	...
"Nelson."	1·56	10	6	14665	·51	06508	·45
	Maximum amperes, 65.						
Repeat test— The "Nelson" to	...	...	...	14665	...	06508	...
"Prince of Orange." Return to the	...	...	...	14690	...	06513	...
"Nelson."	1·56	8½	6	14700	·45	06514	·386
	Maximum amperes, 62.						

The maximum amperes noted was 65, on a grade of 1 in 19. B.T.H. meter constant, multiply by 20 for watt-hours. Vulcan meter reads direct.

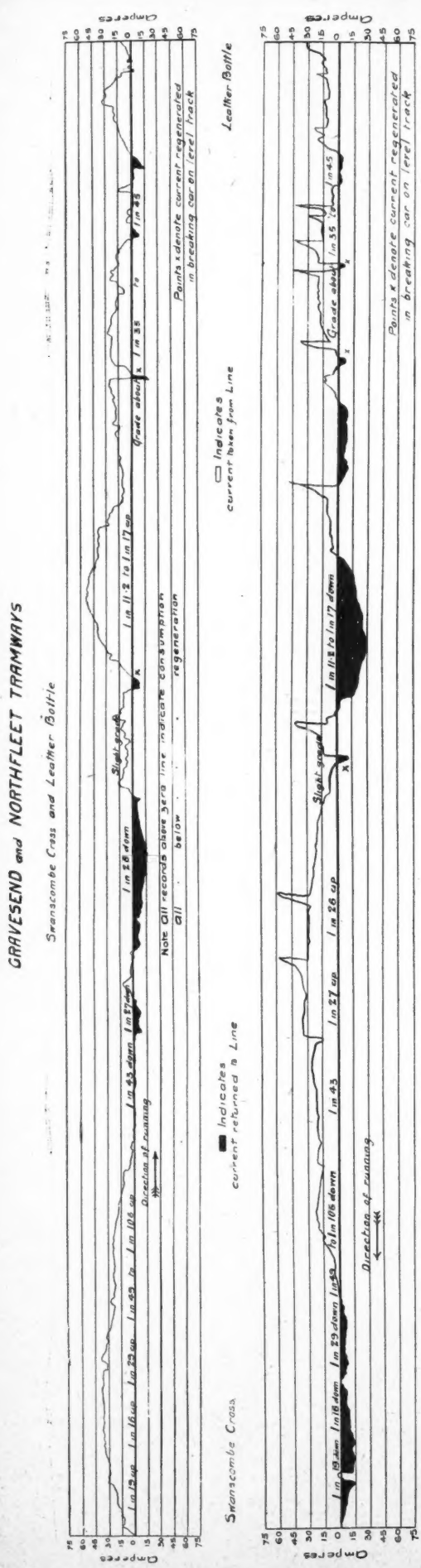
The tests carried out at Gravesend on July 27th, showed that over the whole journey of 6 miles, 28 per cent. of the energy was recovered, and the demonstration, which was intended to show that Raworth's improvements in electric tramway and railway appliances carry with them the potentiality of great increment in the value of tramway and suburban railway property, seemed to make a marked impression on the visitors, nearly all of them, it may be observed, being technical men.

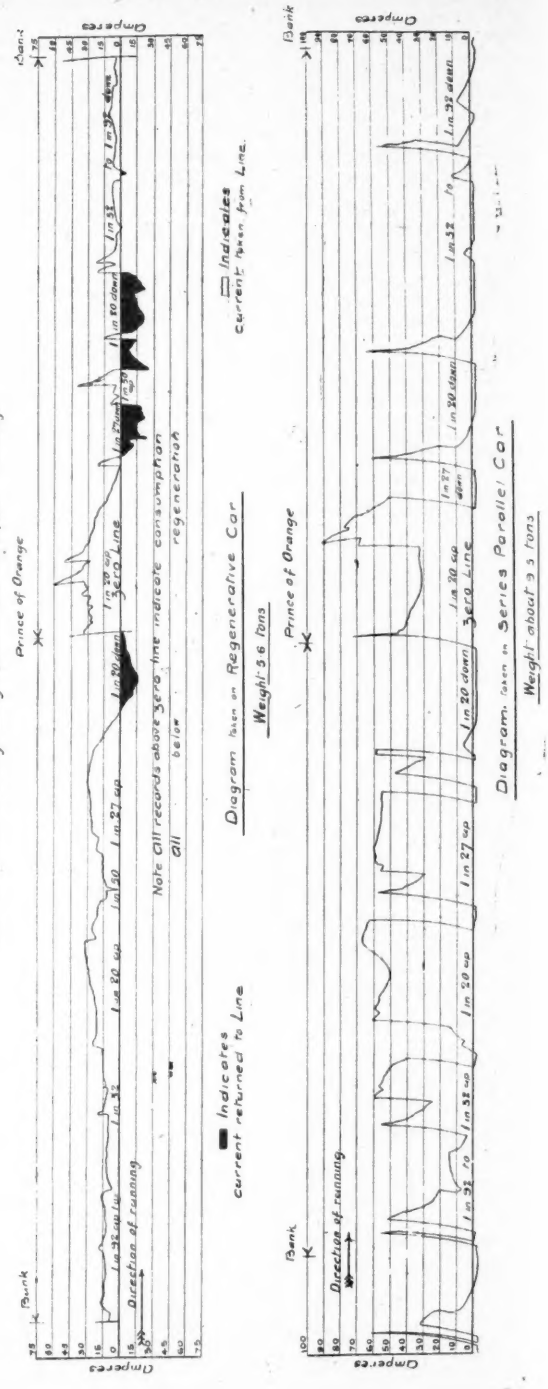
It is claimed, and seemingly on good and reliable grounds, that in Raworth's system nearly the whole of the current transmitted by the lines is usefully employed in the cars. That this is not the case with the series-parallel control has been amply demonstrated by Mr. Mordey, who, from an examination of the performance of the trains on the Liverpool Overhead Railway, finds that of the total energy supplied about one half is wasted in heating the brakes, a fourth is squandered in heating resistances, and the remaining fourth is usefully spent in driving the trains. Thus, the


AUTOMATIC REGENERATIVE SYSTEM OF CONTROL FOR TRACTION MOTORS
SERIES PARALLEL SYSTEM OF CONTROL
Diagram taken on Automatic Recording Ammeter showing current taken from & returned to Trolley line
B Diagram taken on Automatic Recording Ammeter showing current taken from Trolley line C
Indicates current returned to line
Indicates current taken from line
Points X denote current regenerated in breaking car on level track
Weight of Car 9 tons
Bexleyheath Dartford Tramways
Amperes
Zero Line
Direction of running
Terminus
Bottom of Gilbert Road
Top of Gilbert Road
Stanford Place
Crossing
Curve
Tech.l Schools
SNRY Bridge
Bottom of Stone Hill
Millbridge
Slight grade
Wilton St Engd
Pennycomequick Terminus

generating station has to produce, and the lines to transmit, four times as much electrical energy as is usefully employed in driving.

The regenerative system, of course, appears to the best advantage in hilly districts, but even on level lines it can be introduced with good results, for although the amount of electrical energy expended in driving the car is not much reduced, the driver's control is greatly improved, and time which under ordinary conditions would be wasted in the car-shed in adjusting and replacing brakes is


GRAVESEND and NORTHFLEET TRAMWAYS
Swanscombe Cross and Leather Bottle
Swanscombe Cross
Leather Bottle
Amperes
Indicates current taken from Line
Indicates current returned to Line
Note All records above Zero line indicate consumption
All below regeneration
Points x denote current regenerated in breaking car on level track
Direction of running
Grade about 1 in 35
Weight of Car used during test 5·6 tons


Bank and Prince of Orange — Gravesend and Northfleet Tramways
Diagram taken on Regenerative Car
Weight 36 Tons
Prince of Orange
Bank
Amperes
Indicates current taken from Line
Indicates current returned to Line
Note All records above Zero line indicate consumption
All below regeneration
Direction of running
Diagram taken on Series Parallel Car
Weight about 35 tons

entirely saved, whilst the saving effected in the repair and renewal of brake blocks and wheels is enormous.

During the Gravesend trials, each car was fitted with an ammeter with zero in the middle of the scale, and one car was supplied with a watt-hour meter for measuring the net consumption of electrical energy.

The run to the "Leather Bottle" was made as in ordinary service, and regenerative effects were observed in slowing down to take the points on entering passing places.

On the run to Swanscombe, the braking and regenerative effects were shown on a grade of 1 in 11, and the experiments also showed: (*a*) the lowest speed with regeneration, (*b*) the lowest speed on electric brake, (*c*) the lowest speed on emergency brake, (*d*) the braking effect with trolley off the line.

On arrival at the Swanscombe terminus the operation of the controller was explained, and on arrival at Windmill Street the meter was read, and the consumption announced.

The points to which special attention was drawn were the following:—

The demi-car with regenerative control uses less than half the energy per car-mile that is required by the ordinary cars with series-parallel control. The driver can control the car with one finger. The car can run up to facing points at full speed until the buffer is over the points. The brakes are never used except on an incline, to hold the car after retardation. There are three definite braking effects:—(1) Regenerative, which will reduce the speed to 4 miles an hour. (2) The ordinary braking stop, which reduces speed to about 1½ miles an hour. (3) The emergency stop, which pulls the speed up to ½ mile an hour. Sand is seldom required, because the adhesion is not overtaxed. The maximum call on the power station is reduced by 40 per cent. The maximum speed of the car can be fixed in the depôt. The driver cannot possibly exceed this speed, even on a descending grade. The controller is extremely simple, and is sparkless if properly worked, *i.e.*, without hesitation. There is no advantage gained by shutting off power at section insulators. The car lamps remain bright. Every power position of the controller handle is also a braking position on a down grade, or on a level by retiring the lever one notch. The act of shutting off the power applies the brake, and the braking effect is continuous throughout the movement. The motors are in series and remain so. They might equally well be in parallel, but the windings would have to be finer and more expensive. The power circuit is never shut off until it is necessary to stop. In the meantime the car can take power, can coast or regenerate as the road requires. The feeder losses are reduced by one-half, and the size of the power station by one-third.

We put the following questions to Mr. Raworth, and his replies are appended :—

1. Are any records available, obtained under similar conditions on the same route with ordinary series motors and series-parallel control, with which the consumption of energy observed can be compared?
2. If so, what is the percentage saving?
3. What proportion of the energy saved is due to regeneration on down grades, and what proportion to regeneration during braking periods?
4. What type of electric brake is used—rheostatic, disk, or track—in addition to the regenerative braking effect?
5. What type of emergency brake?
6. When the trolley is off the wire, how is the braking effected? [This may be covered by (4)].
7. Are there two motors or one on each car? If two, are they controlled in parallel, or in series-parallel?
8. If not the latter, *can* they be controlled in series-parallel when there are two motors fitted?
9. What percentage of the energy required to run up a given incline against gravitation (*apart* from the normal frictional load) is regained when descending the same incline, in this case *including* the frictional load?
10. What is the weight of the electrical equipment, as compared with the weight of the equivalent equipment of ordinary pattern to do the same duty, and the over-all efficiency of each system at various loads?

Mr. Raworth's Replies.

1. The only records available obtained under similar conditions—*i.e.*, on the same route with the same cars and the same motors, some being arranged series-parallel and some regenerative—were taken by Mr. Sudworth at Devonport, and are appended, marked B C (see diagrams).
2. The net result as measured on the car is a saving of about 35 per cent. in electrical energy consumed. The maximum demand per car is reduced about 40 per cent.
3. The saving of energy is not entirely due to regeneration; the total amount of energy expended in driving the car, without counting the amount regenerated, shows a saving. This is accounted for by the fact that in the regenerative car the maximum speed is much nearer to the mean speed than in the series-parallel car, consequently the motors work more efficiently, as is shown by the comparative diagrams herewith marked F and G. Diagram (B C series-parallel) shows that the energy is taken in spurts which produce high speed followed by coasting. Diagram (B C regenerative), shows that the energy is applied continuously, and only to the extent required to maintain the speed, consequently the copper losses in the motors and in the feeders and line are reduced according to the law expressed $w = c^2 R$. It is impossible to express the amount of regeneration in retardation when stopping in terms of the energy recuperated in descending hills, because no two lines are alike, and the number of stops per mile is constantly changing. It is generally admitted that with series-parallel control every stop costs one-fifth of a penny, but with regenerative control this cost is reduced probably to one-twentieth of a penny.
4. At Devonport the cars are fitted with wheel brakes, rheostatic brakes and track brakes, but they have not been successful in averting accidents. The converted cars still carry the wheel brake and the track brake. The rheostatic brake is replaced by the emergency brake, which is practically the same thing, though simpler in operation.

5 and 6. The emergency brake consists of a series winding on the field magnets which, in the event of the trolley leaving the wire, the circuit-breaker opening, or the shunt field circuit being broken, enables the driver to convert his motors into ordinary series motors on short circuit; the effect is to stop the car rather abruptly—the braking effect is not too severe, because the series winding is of small section and has a comparatively high resistance.

7. It is immaterial whether there be one, two, or four motors—they may be coupled in series or parallel, but no change from series to parallel is required. At Southport there is only one motor, but the armature has many more turns. When two motors are used in parallel, they must have a few turns of series winding to equalise the division of energy between the two.
8. It is possible to work in series-parallel, *i.e.*, changing from one to the other, but it involves complication, due to the fact that the field strength must be forced down—it will not die down quick enough. I prefer to use a separate parallel switch which can be changed over when clear of the town; thus a car can be arranged to run up to 14 miles in the town and up to 25 miles in the country.
9. It is very difficult to answer this question, because speed governs everything. On ordinary steep grades 1 in 12, about 60 per cent. is recovered. The theory of the control shows that the amount recovered is the total, minus the rail friction and the motor losses.
10. The electrical equipment is practically no lighter as regards the motors, but the controllers are relieved 50 per cent.

Some months ago it was estimated that there were about 12,000 electric motors employed in driving tramcars and railway trains in Great Britain. In the United States of America the number is probably more than 60,000, but not more than two or three dozen of these vast numbers are worked on any other system than that of the "the series-parallel control."

Some electrical engineers have affirmed that the shunt motor for electric traction purposes is theoretically superior to the "series," and many of the early attempts to solve the traction problem were made with shunt motors, which failed. In those days no shunt motor had a fixed line of commutation; consequently, the variations of current, with field strength independent of those variations, produced violent sparking at the brushes.

The new system of automatic regenerative control, worked out by Mr. J. S. Raworth, is not so much an invention as an example of faith in first principles.

The first experiments made at Devonport with temporary appliances demonstrated the correctness of the theory that, with a very strong shunt field variable by hand, the conditions of tramway service could be complied with, and the advantages of regeneration secured at a very small cost.

The next step was to design a controller which would give the driver perfect control of the car under all conditions of service, without the possibility of an accident occurring through forgetfulness or inattention, and this has been successfully carried out.

Mr. Raworth's pioneer work in the electro-technical industry is too well known to need any commendation from us; suffice it to say, that we feel confident he has introduced a method of working which must appeal to every electrical tramway manager, director and shareholder throughout the civilised world, because it directly affects the pocket, and so goes straight to the heart.

"FREE" LAMPS—A FORECAST.

[COMMUNICATED.]

Now that the lighting season is coming round again and a good deal has lately been heard about the suggestion that "free" lamps should be given to the consumer, it would perhaps not be out of place to inquire into this matter—not so much from the idealistic municipal point of view, but from the sound practical and businesslike one—the only point of view from which any commercial transaction can stand—or fall. The "free" supply of lamps to consumers is by no means a new proposal; it has been carried on in the past, and is now being carried on by many companies, who are, of course, at liberty to do what they like with their funds, or those of their shareholders. It does not follow, however, that it is of benefit to such undertakings, and any remarks which we may make in this connection as regards municipalities, apply equally to companies. When municipalities adopt any such system we have in addition to look at the question from a wider aspect, because public funds cannot be treated in the same manner as private capital.

Of municipalities, the chief experiment has, of course, been made by Bradford; and if it be argued that the system has been a success there, the reply that the undertaking might be still more prosperous without the system is equally admissible. It is the same thing as trying to show how

prosperous England might be, or might not be, under Protection. It is useless to take an isolated case like this; we can only consider the question thoroughly on the premise that it is adopted largely or entirely, when it can be shown that the system is wrong on business grounds, and entirely fallacious in principle; that it cannot benefit the consumer or the undertaking; and that it can be of no ultimate advantage to the community as a whole.

To show that the principle is fallacious and unbusinesslike, it is only necessary to ask whether such a thing as a free gift is known in business. It is true that there are many alleged gifts or prizes, but no one imagines for a moment, except perhaps the most gullible, that these are not paid for in some other way, and often for more than they are worth. The person who obtains a silver watch on returning 50 coupons cut off soap packets, has paid for both soap and watch, and would probably have obtained both more cheaply if they had been bought separately. Of course it may be said that as this is done in business, it is businesslike; but the business of a municipality is to produce electricity as cheaply as possible, consistent with sound management, and not to bolster up the concern by bribes. The methods just described are doubtful ones, and municipal trading should be open and above-board, otherwise all the contentions put forward in its favour by its advocates fall to the ground. By giving "free" lamps, then, the municipality takes away with one hand what it gives with the other; it provides the consumer with electrical energy at a higher rate than he would otherwise have to pay, and with a lamp (if he chooses to claim it) for which it can take no responsibility as to actual efficiency; and if this is not considered fallacious and unbusinesslike, then commercial rectitude is sadly wanting in municipal affairs. This brings us to the consideration of the consumer. We have just shown that he is paying more for his current than if the system were not in vogue, and he were buying the lamps himself. It is probable that he could not buy a really good lamp so cheaply; but how can the municipality guarantee that the lamps it buys in large quantities and provides the consumer with are all good and efficient? In Bradford, for instance, the consumer can claim one "free" lamp for every 60 units consumed. If these lamps are not all good, what is to prevent him from using more energy than if he had bought more expensive lamps in the open market? Probably, therefore, by getting cheap "free" lamps, the consumer's electricity is costing him more than if he were left a free agent to buy his own lamps, which he could do out of the balance, and perhaps still be in pocket. But the station engineer who is infected with municipalism will say: What is to prevent the consumer buying a worse lamp than I supply him with? That is just where you can come in, Mr. Station Engineer. You can advise him, educate him; send him printed notices with every statement telling him to buy a good make of lamp; print it on his meter card, on his receipt form, bring it under his notice whenever and wherever you can. But it is impossible for the station engineer to expect to supply the consumers with a good lamp; municipalism plumps for the cheapest article, and the lowest tender is accepted. That is the inevitable tendency, and, therefore, the consumer will not in the end be supplied with a good lamp, *e.g.*, his electricity will "cost him more," and he will not benefit.

Now as to the supply authority. It is admitted that the station engineer has much to complain of. His consumers (if uninstructed, as most of them are) will buy cheap foreign lamps, and he is then pestered with complaints about bad light and low pressure, which he generally traces to inefficient lamps. It is natural, therefore, that he becomes bitten with the idea of supplying the consumers with approved lamps, an idea which is, of course, fostered by his councillors, who are full of altruism. But we have shown that he cannot expect to be able to supply a good lamp, and, in any case, he is not able to reduce the cost of energy. Of course he thinks that the "free" lamps will act as a bribe to intending consumers; but is not the latter much more likely to be drawn into the fold when he finds that the rate is being reduced, and that the cost of electric light is coming nearer and nearer to that of gas. He will waive the difference for the extra comfort and cleanliness. Again, with a system of free lamps, the consumer will feel that he has now got a stick to beat the Corporation with, who will be held responsible for all supposed bad lamps supplied. Naturally this means a special department to cope with distribution, complaints, and tests; it means the engagement of clerical labour and inspectors, storekeepers, &c., and a considerable amount of extra worry for the station engineer. Under the circumstances, it may be asked in what measure the undertaking will benefit.

There is one further aspect of the case. With a "free" lamp system adopted, the local retail trade is destroyed, and all healthy competition in lamps is stopped. This not only reduces the retailers' turnover and profits, but their capacity to sell in other districts as well; for a retailer may buy 10,000 lamps a year at, say, 8d., and retail them at 10d. in his own town and in other districts; but if his local trade is stopped, he buys less lamps, and pays a higher price for them. He is thus unable to compete with more fortunate retailers in other towns. The effect will be to lessen the circulation of money in the town, and to cause a feeling amongst the retailers that the next thing to go will be their trade in accessories and fittings.

Naturally, then, they will be antagonistic to the municipality and to the undertaking, and all this will not tend to benefit the community. But, further, if the system were to become universal (and we must assume this as stated at the outset), then the community would suffer still more. For healthy competition, as between retailer and retailer, and lampmaker and lampmaker, would be destroyed everywhere. Now the lampmaker recoups himself for the few large contracts at cut prices, by the many small ones at prices giving fair profits. But with universal "free" lamps there would be nothing but large contracts going, and makers would carry on a cut-throat competition in order to live. They could not afford to lose many such contracts, and the result would be low prices, with very small profits. This would lead to less careful supervision in the making of lamps in order to reduce expenses, and if the consumer were not worse off then, he would undoubtedly be so when the makers combined to put up the prices, as they certainly would do in the end. The result would be higher prices for lamps than before, and electricity would become more of a luxury than ever. Of what advantage would all this be to the consumer, the undertaking, the community at large—in fact, to all except the lampmakers? Can anyone say? If so, let him stand forth.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Localisation of Earths.

Many thanks to Mr. A. J. Howard for replying to my query. His method is not mine, however, but it is a *good tip*, and will be useful. I will say no more now, as I am busy. This is a favourite subject of mine, and when I get wound up there is no stopping me. I will ask your permission, sir, to submit an article on this subject at some future date.

G. C. Knight.

Finchley, *August 9th*, 1904.

[We shall be very pleased to facilitate the further discussion of this important subject.—Eds. E.R.]

One might imagine from Mr. Blaikie's remarks that the system employed by me is an expensive one, whereas the whole object I have kept in view has been to reduce the cost of localising faults. He does not suggest another way which would be better, except the "cut and try," which, as every engineer knows, is barbaric and most expensive, as well as taking considerable time, which is of great importance. The system in use in Tunbridge Wells works admirably, costs very little in time and labour, and does not, as Mr. Blaikie seems to think, result in the fault being sometimes localised once or twice in the wrong place. To show the

accuracy of the method employed, I gave a table of actual consecutive results, and any other methods described or suggested are, in my opinion, useless, unless they have withstood thorough practical tests, and the tabulated results are given.

I do not see why, in the localisation of faults, the sectional area of the cable should affect the accuracy of the results; the resistance is balanced by the wire bridge, and, provided the current used is of sufficient amount, no trouble need be experienced. I may mention that it is our practice to employ 100 amperes to the square inch. Under certain conditions, a regulating resistance and an ammeter might be an advantage to protect the accumulator.

Mr. Knight speaks of the difficulty experienced in flexible leads; I have not found this to be the case, as it is perfectly easy to allow for the value of the leads, as compared with the cable under test. I admire Mr. Knight's ingenuity in getting over this supposed trouble in dividing his bridge into 100, less two parts, and making the terminals in the cable box the actual terminals of his bridge; on the other hand, however, this method has its drawback, for in the first place, as every mains engineer knows, the ordinary disconnecting joint-box is not of such a size, as to make it desirable to connect more than one pair of leads on to one pair of its terminals, with other live terminals close round them; and in the second place, with the system in vogue in this town, the testing set is sent out on a hand-cart kept for the purpose, already connected up for testing, so that all that it is necessary to do on arriving at the test pit, is to connect two leads on to the inner and outer terminals of the dead cable, one wire to earth, and conduct the test.

Mr. Knight would find it more convenient to divide his bridge into 198 plus 2, as he could then read the direct percentage of the distance along the fault. As the galvanometer is connected in series with the fault in fig. 1, and as it is a very high resistance, it only requires a very small current to deflect it, a few ohms more or less in the fault does not make any difference to its sensitiveness, in fact, the fault really becomes one of the galvanometer leads. I am obliged for pointing out the slip in the word "across," it should be "in series with the fault." I still maintain that its resistance does not matter, because at the time of the balance no current is flowing through same. With fig. 2 Mr. Knight is wrong in saying that the resistance of the fault does not matter, and if he were to try both methods he would soon find which was the better. If the resistance of the fault is very high, he will find that he requires a donkey to draw his battery, although, in his case, where he has current and uses a lamp, I cannot understand how he can get any accurate result whatever, with so small a current as that which will go through an ordinary 16-c.p. lamp. Of course the drop in potential must always be exceedingly small, and therefore large current density is required, which he certainly cannot get with an 8 or 16-c.p. lamp in series. I have tried the fig. 2 connection with a large battery and cells, and then cannot as a rule get a sufficient current through the fault. It is quite possible that Mr. Knight and myself have been working on the same subject about the same time, but at the dates I have in my book, viz., July 21st and 31st, 1903, in which the faults were found out with this system, it was found of considerable advantage to make use of *services for short circuiting*; I certainly did not notice his letter in the Review a month later, as I was away at the time. However, Mr. Knight is quite welcome to any honour which may attach to his finding it out, as I am quite willing to content myself that I have been using it independently for some time previously, but owing to pressure of work it is impossible to communicate one's everyday doings to the technical Press. May I ask Mr. Knight to publish in tabular form the results he obtained at that date, or during last year, with the system he advocates, as it is a very fascinating subject, and deserving of more notice than is usually given to it.

With regard to Mr. Howard's letter, I must say I have at no time found it necessary to employ a second good cable to discover a fault on a bad one, as the addition of some four or five thousand yards of cable will not tend to aid the accuracy of the results; further, I do not quite see the necessity of having to conduct the same test practically twice over, as he suggests should be done, as it is purely a waste of valuable time, unless his staff is blessed with the use of a motor-car to run up and down the cable under test. As regards the resistance of the earth fault, I have found it quite easy to locate one having a resistance of 50,000 ohms; of course, if the fault is of a much higher resistance than this, a little high-pressure current through it, certainly would be of some assistance.

I am not at all surprised at "Non-holiday Maker" not succeeding with the test, which I have given up myself, owing to inaccurate results. The reason I recommended a slide bridge of about ·5 ohm, is because it was as near as possible the average resistance of the sections of our distributors, it being advisable to make the opposite sides of the bridge as nearly as possible the same resistance.

Horace Boot,
Consulting and Resident Engineer.

Tunbridge Wells,
August 6th, 1904.

Nomenclature.

Now committees are all the fashion, might we suggest that the Institution of Electrical Engineers call one for the purpose of inventing a new name for the electric motor?

The life of the electrical contractor at best is not a happy one, and lately a new burden has been added to his shoulders by the constant necessity of explaining that a "motor" does not necessarily mean a vehicle with a vibrating machine underneath and a smell behind.

As power contractors, we write feelingly on this subject, and no doubt others like ourselves are tired of informing their friends and relatives they are *not* busy installing motor-cars.

We expect many of your ingenious readers could oblige with suitable names for the Committee to sit upon.

Motoria.

[We cordially sympathise with our correspondents. The petrol people have most improperly appropriated a term which the electricians had already annexed!—Eds. E R.]

[We have received a letter signed by "One in the Know," asking why the recent vacancy of superintendent of rolling-stock and trainer of tramcar drivers at Halifax was not advertised, and on what grounds it was recommended that the manager's son should secure the post? The writer considers that there are many thoroughly experienced men who would accept the position at £120 per annum, and be glad to do so. We regret that we cannot publish the letter, owing to its general tone and the personalities it contains.—Eds. E R.]

LEGAL.

Pattison *v.* J. G. White & Co.

In the Court of Appeal on Friday, August 5th, the Master of the Rolls and Lords Justices Stirling and Mathew had before them the case of Pattison *v.* J. G. White & Co., which was an appeal by defendants against an award of the judge of the Darlington County Court sitting as arbitrator under the Workmen's Compensation Act, 1897. The facts which were not in dispute were these:—The defendants, who are a firm of engineers, were employed by the Corporation of Darlington in the construction of a system of light railways in Darlington under an order of 1902. The plaintiff was the widow of a man named John Moye Pattison, who was employed as a cartman by a contractor named Peter Wilkinson, who had contracted with the defendants (*inter alia*) to haul some sand in connection with the works. While engaged in carting sand from a place near Croft to the works, Pattison was accidentally killed, the scene of the accident being 2½ miles from the works. The defendants admitted that they were undertakers within the meaning of the Act in respect of the work, but it was contended on their behalf that the case did not fall within the meaning of Sec. 7 of the Act, as the accident happened at a distance from the works, and that, therefore, the employment of Pattison could not be said to be "on, in, or about" the engineering work in question. On the other hand, it was argued, on behalf of the plaintiff, that, inasmuch as, by Clause 89 of the specification, the defendants were bound to use the best river or pit sand, the employment of the deceased in bringing such sand from a distance to the works was clearly employment "about" an engineering work. The County Court Judge came to the conclusion that, even if the words "on, in, or about" imputed locality or proximity in the case of a quarry,

mine, &c., it did not necessarily do so in the case of an engineering work, and, taking a broad view of the meaning to be placed upon the word "about," it seemed to the learned judge to be clear that the deceased, at the time of the accident, was employed in going to fetch sand necessary to his employers for the construction of the engineering work which they had in hand. In his judgement, the defendants were "undertakers" in respect of the employment of the deceased "about" the engineering work, notwithstanding the fact that the accident occurred at a considerable distance from the scene of work where the sand would be ultimately unloaded or used. To hold otherwise appeared to his Honour to put a narrow and harsh construction upon the word "about," and to limit it to the preceding words "on or in," and to curtail the boons and privileges of workmen which the whole spirit of the Act intended that they should fully enjoy. The learned judge therefore made an award in favour of the plaintiff and his children of £187 4s.; hence the present appeal of the defendants, in support of which it was argued that the learned judge had put a wrong construction upon the meaning of the word "about" in Sec. 7.

Mr. Arthur Powell, K.C., and Mr. Willis appeared for the appellants, and Mr. Manesty, K.C., and Mr. Taylor for the respondent.

The Master of the Rolls, in giving judgement, said that this appeal must be allowed, the case clearly being covered by previous decisions of the Court. The County Court judge had apparently emancipated himself from those decisions, and arrived at a broad decision. It was quite plain that for the plaintiff to recover, the scene of the accident must be the physical locality, where the work was being carried out. In this case the accident having occurred a considerable distance from the engineering work, the case was outside the Act.

Lords Justices Stirling and Mathew concurred, and the appeal was allowed with costs, the award of the County Court judge being set aside.

Brunlees *v.* Mersey Railway Co.

This case, which came before Mr. Justice Lawrance in the King's Bench Division on Friday, was an action by Mr. John Brunlees, a well-known engineer, to obtain a declaration that an agreement which was made between himself and the defendants, who are the owners of the Mersey Tunnel, and the railway running through it, is still subsisting. The agreement in question had reference to his appointment as joint chief engineer of the company with Sir Douglas Fox. Plaintiff also claimed damages for not having been engaged in connection with the electrification of the railway when the defendants gave a contract of £250,000 to the British Westinghouse Co. The defendants disputed the validity of the agreement, and said that it had lapsed, and did not apply to the particular works in question.

Mr. Duke, K.C., and Mr. Rowlatt appeared for the plaintiff, and Mr. Lush, K.C., and Mr. Ashton represented the defendants.

Mr. Duke, in opening the case, stated that the company's engineers had been the well-known Sir James Brunlees and Sir Douglas Fox. The former was in partnership with his son, the present plaintiff, and Sir Douglas Fox was also in partnership. In 1881, the company commenced their undertaking, and on May 24th, 1881, the agreement was made which was in question in this case. It was an agreement by which the then Mr. James Brunlees and the then Mr. Fox were engaged as engineers to the company, and there was a clause in the agreement that upon the death of Mr. James Brunlees his partner, Mr. John Brunlees, the plaintiff, should be employed, and upon the death of Mr. Fox his partner should be employed. Sir James Brunlees died in 1892, and the plaintiff then became retained with Sir Douglas Fox as one of the chief engineers. In 1901 the defendant company entered into a contract with the British Westinghouse Co. for the introduction of electric traction on their railways, and for carrying out very considerable engineering works at a total value of £250,000. The plaintiff claimed that he was entitled to be employed by the company in connection with these and other works in accordance with his contract, but the defendant company disputed this. Under these circumstances the plaintiff brought this action to ascertain his rights.

Mr. John Brunlees, the plaintiff, was then called, and he gave evidence in support of his case. He said he built Southend Pier, upon which electric trams were run, and he was also consulted in the London to Brighton electric railway scheme.

Cross-examined, Witness stated that the latter scheme was started to connect London and Brighton by electric railway. With Mr. Cheesewright he was to act as chief engineer, but the promoters of the scheme did not obtain a Bill from Parliament. He could not give any other instances in which he was connected with the construction of an electric railway. He claimed 5 per cent. on the Westinghouse contract, and the total amount of this claim was £10,000. His contention was that the company were bound to employ him as long as he lived, and to pay him 5 per cent. on all rolling stock they bought, extensions they made, and changes they effected in the working of the line.

The hearing was continued on Monday.

Mr. A. L. Stride, managing director of the London, Tilbury, and Southend Railway, said that, in electrifying a railway, a great proportion of the work ought to be done by the railway engineer. The division of labour was not very clearly defined, but he should have no difficulty in co-operating with the electrical engineer. He could not understand this case coming into a court of law. He was also connected with the District Railway Co., and in both companies the chief engineer was held responsible for the electrical work that was now being carried out.

This finished the plaintiff's case.

Mr. Montague Lush, K.C., in opening the defendants' case, submitted that the agreement was *ultra vires*, and that no board of directors could tie the hands of their successors, and prevent them carrying out their statutory duty by entering into such an unheard-of arrangement as this alleged perpetual contract. The claim of the plaintiff to get 5 per cent. commission on the electrifying of the line was an absurd one.

Mr. J. Falconer, Writer to the Signet, Edinburgh, chairman of the defendant company, said all the authorised extensions of the railway had either been abandoned or completed. He had never seen the plaintiff until last Friday, and he had had no correspondence with him until this claim was made, and he was not aware of the consultations which he had had with Sir Douglas Fox. In the contract with the Westinghouse Co., the railway company expressly stipulated that there would be no right on the part of their engineer to interfere in the construction of the work. There was no position under this contract for a consulting engineer like Sir Douglas Fox or Mr. Brunlees.

Cross-examined by Mr. Duke, K.C., Witness said he was not aware until preparation of this case was being made that Mr. Francis Fox had, at the first meeting after Sir James Brunlees's death, announced that Mr. John Brunlees had succeeded his father.

On Tuesday counsel addressed the Court.

Mr. Montague Lush, K.C., for the defendant company, said the first point was one of construction of the contract.

His Lordship observed that the whole thing depended on the construction; the evidence carried the question very little further on either side.

Mr. Lush said his Lordship must be guided first of all by the surrounding circumstances which existed when the contract was made. The scope and object of the contract was to carry out the railway that had been authorised, which was to be worked by steam, and no other power, and the two engineers who were to bring this about were Sir James Brunlees and Sir Douglas Fox. But the contract never meant to give these gentlemen a life interest in the railway if it were electrified. If the plaintiff's case was to be maintained, it would mean that whenever the defendants bought rolling stock, he was to get 5 per cent. on the cost. Even if the directors of the company had made such a contract as was alleged by the plaintiff, counsel argued that they had no power to do so. The plaintiff's contention was preposterous.

Mr. Duke, K.C., for the plaintiff, maintained that he came under an agreement to act as engineer generally in succession to Sir James Brunlees.

His Lordship reserved judgement.

Templeman *v.* Johnson & Phillips.

Plaintiff, a merchant of Weymouth, claimed damages for injuries caused to a horse which slipped into an insufficiently-protected electric lighting trench. The jury at Weymouth County Court awarded £50 (the full amount claimed) and costs.

PARLIAMENTARY.

Belfast and North-East Ireland Electricity and Power Gas Co.

This Bill, which was to incorporate a company with the above title for the erection of buildings and for the manufacture of power gas and the generation of electricity, came before a Select Committee of the House of Commons on Unopposed Bills on Wednesday last week.

The promoters took power to acquire by agreement (but not otherwise) the rights, &c., of any local authority or other undertakers within the company's area of supply to whom a provisional order might have been granted under the Acts of 1882 and 1888. The power gas was to be generated on the Mond system.

Formal evidence was given by Mr. Wilson, one of the promoters, who, in reply to the Hon. Sir Chandos Leigh (one of the Committee), said that the capital of the company would be £1,500,000, in shares of £1 each.

The Bill, which was stated to be the first of its kind in Ireland (a similar Bill for the South of Ireland having been dropped some time ago), was allowed to proceed.

Electric Lighting Provisional Orders (No. 3).

This Bill, promoted by the Board of Trade for the confirmation of the following provisional orders relating to electric lighting, came before Sir James Woodhouse's Select Committee of the House of Commons on Thursday last week:—

Birkenhead Corporation Electric Lighting (Extension) Order.
Bishop Auckland Electric Lighting (Amendment) Order.
Huddersfield Electric Lighting (Extension to Golcar) Order.
Maidenhead Electric Lighting (Extension) Order.
Milford-on-Sea Electric Lighting Order.
Newquay Electric Lighting Order.
Penzance Electric Lighting Order.
Ramsgate Electric Lighting Order.
Sunderland Electric Lighting Order; and
Tavistock Electric Lighting Order.

The Bill was ordered to proceed.

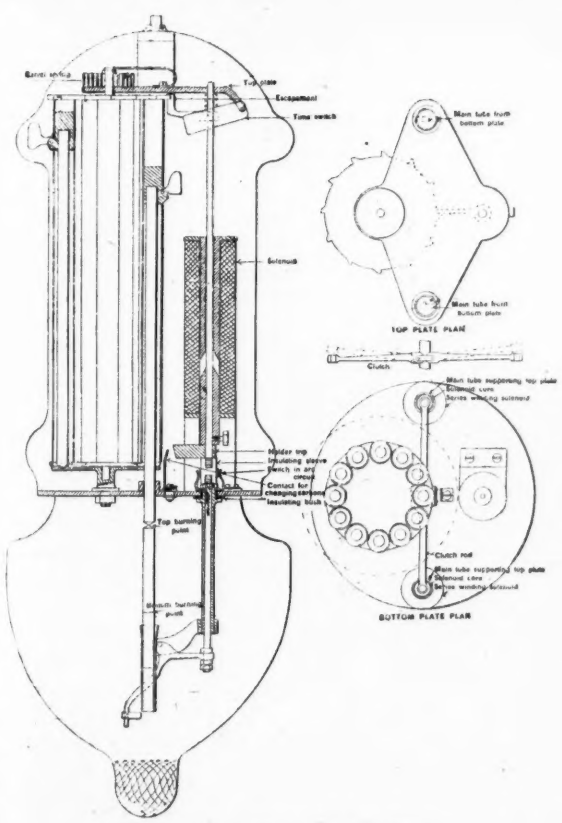
Private Bills.—In the House of Lords, on 5th inst., the Electric Lighting (London) Bill was read a third time.—The Middlesbrough, Stockton-on-Tees, and Thornaby Tramways Bill has also been read a third time and passed. In the House of Commons on August 8th, Belfast and North-East Ireland Electricity and Power Gas Bill, and Belfast Corporation Tramways Bill, were read a third time.

Wireless Telegraphy Bill.—On Wednesday, in the Commons, Lord Stanley moved the second reading of this Bill. He said that two principles underlay the Bill. One was that the safety of the nation in time of danger should be secured by allowing the Government to exercise control of wireless telegraphy; the other was a big monopoly should not be allowed to grow up which some time later the State might have to purchase. Persons engaged in experiments need only obtain registration. The duration of the Bill was limited to two years, so that the measure might then be amended in the light of experience. The Bill was read a second time.

NEW MAGAZINE ARC LAMP.

We recently inspected a new patented magazine mechanism for open and enclosed D.C. or A.C. arc lamps, which presents some novel and interesting features. The arrangement of the mechanism is shown in the accompanying illustrations; it consists in the main of a revolving magazine, a change-over device with delayed action, and an automatic bottom tubular carbon holder.

The magazine is a cage revolving on a vertical axis, and capable of holding 12 carbons, of any length and diameter for which the lamp may be designed. The magazine is controlled by a spring and escapement release, the spring being wound up in the act of refilling the magazine. In the act of changing over, the escapement is actuated by the change-over device, allowing the magazine to turn through $\frac{1}{12}$ of a revolution, so as to bring a new carbon over a hole in a guard plate underneath the magazine, through which the carbon falls by gravity.



Mechanism of Magazine Arc Lamp.

Each carbon is held in the magazine at the upper end by a weighted clutch-holder, the lower end being simply guided by a hole in the end plate of the cage, and supported by the guard plate mentioned above. By the time that the carbons which are in use have been consumed sufficiently, the gradual descent of the upper carbon brings the upper holder into contact with a fixed contact piece, completing the circuit through a solenoid wound with fine wire in shunt to the arc.

The solenoid pulls up an iron core, which simultaneously releases the upper and lower carbons, cuts off the main circuit through the arc, and tilts a timing device consisting of a mercury switch. The lower carbon, however, does not fall out of the lower holder altogether, being retained for a time at the bottom of the tubular holder by a cranked lever, which is brought into position by the change-over device.

The circuit through the arc being broken, the clutch which controls the feed is released, allowing the stump of the upper carbon to fall into the lower holder, on the top of the short stump of the lower carbon, which, as mentioned above, is still supported in the bottom of the lower holder. By this means the new lower carbon is maintained at the proper height during the change-over.

These operations take place almost instantaneously; in the meantime the time switch, which consists of a column of mercury enclosed in a slate chamber, comes into action, interrupting the circuit through the change-over solenoid. This allows the iron core to recoil under the action of a spring, simultaneously closing the switch, clamping the new lower carbon, allowing the spent lower carbon to fall out, and rotating the magazine, which brings a fresh carbon over the hole in the guard plate; the carbon drops through, and is stopped by the end of the previous carbon, restoring the circuit through the arc, which at once lights up. The whole cycle occupies but a couple of seconds, after which the lamp, if of the single enclosed type, is ready to burn for 50 hours before the next change-over occurs. With 12 carbons, it is found feasible to obtain a burning life of 600 hours without recharging, the waste carbon ends being only about 1½ in. in length each. It is found that the globe, which is about 9 in. in diameter, is not seriously blackened during this period.

If the lamp is of the open type, the burning period is correspondingly shorter. When the magazine is emptied, the stump of the last top carbon falls into the lower holder ready for use, whilst both shunt and series circuits remain broken until the magazine is refilled.

The shunt circuit is closed only during the operation of changing over, and the switch may be arranged so as to substitute a resistance for the arc during this period, thus enabling the lamp to be run in series with others.

We have seen the lamp automatically change over in this way under normal working conditions; the operation was performed without the slightest hitch, and the arc immediately lit up again as if nothing had happened, without flickering or pumping. We understand that the mechanism is fully covered by patents, and a syndicate has been formed to place the lamp on the market. The original model was constructed at 62, Stoke Newington Road, N., by the Stoke Newington Motor Co., to whom we were indebted for an opportunity to see the lamp in operation.

SIMPLE STORIES.

By "INNOCENS."

VI.—The Inventor's Meed.

A certain Man worked for a Firm. And as he worked, an Idea came unto him. And not being used to such things he laid down his tools that he might think it over.

But the Foreman, perceiving this, straightway came for him and asked him in chromatic and elliptic language wherefore he laboured not. Then said the Man unto him, "Verily, I have an Idea!"

And the Foreman answered him, "Thou unprofitable labourer! By what right and by what authority dost thou have an Idea in thine employer's time? Labour thou with thine hands, and sweat thou with thy brow! For I, even I, will do all the thinking that is necessary in this shop!" This said he for that he was wroth; for he never had an Idea.

And the Man answered him, "Nay, but this is an Idea whereby the arc-lamp mechanism whereon I labour may be greatly improved. The cost of production will be diminished, and the simplicity thereof will be such as thou hast not imagined in thy dreams." And taking in his hand a piece of chalk he drew diagrams upon the bench.

The Foreman therefore looked on with an haughty expression, and when the Man had finished he turned and rent him for wasting his time.

Nevertheless, at the sixth hour, he cometh privily unto the Works Manager, saying, "Lo! I have somewhat to impart unto thee!" And the Manager answered, "Say on!"

And he said, "It came to pass that, as I was walking my shop, and bossing my men, an Idea came unto me, whereby thou mayest effect great economies in the production of thine arc-lamp mechanism."

And the Works Manager was astonished at the saying, for he deemed the Foreman incapable of invention. Nevertheless, he was very gracious unto him, saying, "Speak thou all that is in thy mind!"

Thereupon the Foreman attempted to reproduce the diagrams that the Man had shown unto him. And not having understood them, he got into an hopeless mess. Then said he, "Verily, when I had the Idea, I incautiously

mentioned it to the Man that worketh upon these mechanisms, and he hath made foolish suggestions that have muddled me!"

The Works Manager, therefore, having passed two-score and ten years in a sinful world, saw unto the truth of the matter, and smiled, saying, "To-morrow, at the ninth hour bring hither that workman with thee unto me. Peradventure he will, by repeating his foolish suggestions, clear thy mind for the Idea that is thine."

And as the Foreman departed, he cursed three curses—one for the smartness of the Works Manager, one for the Idea of the Man, and one for his own stupidity.

The Man therefore explained his Idea unto the Manager and the Manager saw that it was good. He said therefore unto the Man, "Leave thy bench, and go into our Experimental Department and labour thou there. Our specialist shall assist thee until thou hast perfected thine Idea. Then come thou again unto me, and the Firm shall recompense thee."

After many days the Man returned, saying, "Lo, here is the mechanism which I conceived, and it worketh beautifully. What, therefore, wilt thou give me for mine Idea?"

And the Manager replied, "Tarry a little, till we get the lamps upon the market and make a profit thereby. Then shalt thou have thy reward."

So the Manager straightway patented the Idea in the name of the Firm, and it was put upon the market. And the firm profited thereby to the extent of four hundred and thirty pieces of gold in the first year, for the lamp was very good.

The Man, therefore, came again unto the manager, saying, "Where is the reward thou promisedst me? For I have seen the balance-sheet of the Firm, and lo! the profit is very great."

And the Manager smiled benignantly, and handed him a fiver, saying, "Take thou thy reward, for we believe in encouraging our employés to take an interest in their work." And he was pained at the attitude adopted by the Man, and ordered him out of his office.

The Man therefore consulted a Lawyer who lived on Small Fry. And he, having induced the Man to sign divers documents whose purport was unintelligible, wrote a threatening letter to the Firm.

The Manager therefore kicked the Man out of employment and instructed the Firm's solicitors.

And when the case came for trial it was definitely proved that the Man was an artizan employed in the Experimental Department, and that the Specialist had had the Idea.

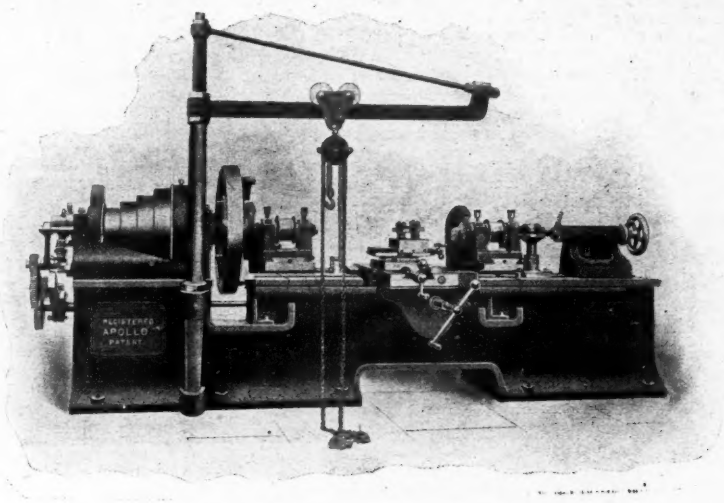
The Lawyer who lived upon Small Fry therefore came upon the Man for his costs; for this is apparently what the documents were about.

The Man therefore, he and his family, went into the Workhouse.

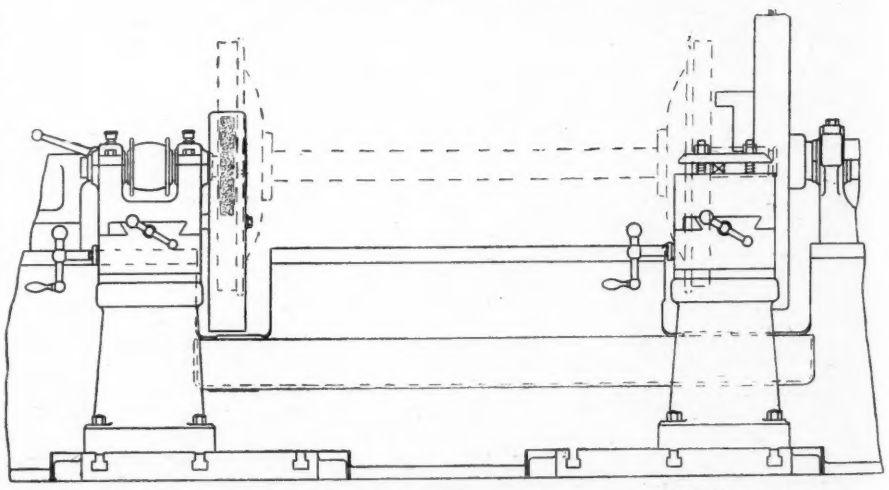
Moral: Whom the Gods wish to destroy, they first make inventive.

THE "APOLLO" TRAMCAR WHEEL LATHE.

Messrs. Pollock & Macnab, Ltd., of Britannia Machine Tool Works, Bredbury, near Manchester, have placed on the market a combination tool which would appear to be very suitable for car-repairing shops, perhaps more especially for the smaller ones where insufficient work is on hand to keep several separate tools employed.



General View of Apollo Lathe.



Back Elevation of Lathe, Showing Grinding and Turning Tools.

The Apollo lathe is constructed to do ordinary turning and boring, and is provided, in addition, with grinders for truing up the rims of chilled wheels. It can, as a further addition, be provided with screw-cutting attachments.

From the general illustration it will be seen that the bed is of rigid design, and is provided with gaps for the two wheels; the grinding machines are at the back of the bed. The chuck is of the self-centring type, gripping up to 30-in. diameter on the tread, for the purpose of boring, &c., or gripping the axle when grinding or turning the tires.

The lathe is provided with a crane and a pair of pulley blocks, thus rendering the operator independent of other lifting gear or assistance. It is pointed out that no change of parts is required for any of the operations, which is a great advantage where frequent changes from turning to grinding are necessary.

The machine is supplied to perform any one of the specified duties singly, and can be added to as required for additional operations. It will be seen that the machine is adapted for dealing with either chilled wheels or shrunk steel-tired wheels, a matter of some moment at the present day.

BUSINESS NOTES.

For Sale.—The Salford Corporation is inviting tenders for the purchase of 165 Shallenberger meters. See our advertisement pages to-day.

Electrical Wares Exported.

Week ending Aug. 4th, 1903.

Alexandria	Value £31
Amsterdam	46
Antwerp	34
Beira	33
Bilbao	12
Bombay	635
,, Teleg. mat.	62
Boulogne	25
Buenos Ayres	90
Calcutta	279
,, Teleg. mat.	4,760
Cape Town	1,869
Channel Islands	30
Chemulpo	65
Durban	440
,, Teleg. mat.	40
East London	163
Hamburg. Teleg. mat.	610
,, Teleph. apparatus	56
Hong Kong	46
Kobe	29
Melbourne	142
,, Teleg. wire	1,377
Montreal	21
North Atlantic. 100 knots telegraph cable	—
Oporto	49
,, Teleph. mat.	61
Perth	218
Rotterdam	970
Seville	13
Shanghai	105
Stockholm. Teleg. wire	64
Sydney	1,142
,, Teleg. mat.	477
Yokohama	359
,, Teleg. mat.	70
Total	£14,423

Week ending August 2nd, 1904.

Adelaide	Value £25
Alexandria	324
Auckland	20
,, Elec. machinery	370
Bombay	246
Buenos Ayres	180
Calcutta	1,034
Cape Town	163
Channel Islands	78
Colombo. Teleg. mat.	98
Copenhagen	213
Durban	849
,, Elec. machinery	506
East London	410
Hamburg. Elec. machinery	65
Hobart	45
Lyttelton. Teleg. cable	180
Madras	373
,, Teleg. mat.	65
Mauritius	93
Melbourne	64
Montreal	40
New York	29
Penang	315
Port Elizabeth	261
Rangoon	17
St. Petersburg	552
,, Teleg. cable	552
San Sebastian	18
Shanghai	335
,, Teleg. mat.	67
Singapore	75
,, Teleg. mat.	75
Sydney	222
Tokio	105
Toronto	195
Wellington	156
,, Teleg. mat.	200
Total	£8,563

Foreign Goods Transhipped.

Kobe. Elec. apparatus.	Value £131
Nagasaki. Elec. mat.	51
Perth. Elec. mat.	23
Shanghai. Elec. carbons	155
Total	£360

Durban. Elec. mat.	Value £45
,, Teleg. cable	62
Stockholm. Teleg. mat	50
Total	£157

Electrical Wares Exported.

Week ending August 11th, 1903.

Adelaide	Value £262
Alexandria	10
Amsterdam	85
Auckland	200
Bangkok	173
Bombay	210
Calcutta	1,254
Cape Town. Teleg. mat.	202
Colombo	51
Durban	51
East London	220
,, Teleg. mat.	256
Gibraltar	31
Grenada	47
Hong Kong	2,132
Lisbon. Teleph. cable	60
Madras	157
Melbourne	138
Monte Video	44
Penang	38
,, Teleg. apprts.	70
Port Elizabeth	16
Rio Janeiro	49
Rotterdam	88
Shanghai	141
Singapore	824
Sydney	208
,, Teleg. mat.	27
Wellington	24
Total	£6,468

Week ending August 9th, 1904.

Adelaide	Value £35
Alexandria. Teleg. mat.	255
Amsterdam	258
Auckland	108
,, Teleph. mat.	284
Bangkok	179
Boulogne	60
Brisbane	116
Buenos Ayres	55
,, Teleph. mat.	340
Calcutta	394
,, Elec. machinery	929
Cape Town	164
,, Elec. machinery	120
,, Teleg. mat.	178
Colombo	76
,, Elec. machinery	177
Delagoa Bay	491
Durban	231
,, Elec. machinery	1,147
,, Teleg. mat.	495
Fremantle	25
,, Elec. machinery	61
Gibraltar	68
Hamburg	10
,, Elec. machinery	12
Hong Kong	110
,, Teleg. mat.	306
Kobe	36
Madras	94
Melbourne	98
Nagasaki	80
Penang	77
Pernambuco. Teleg. cable	10,400
Perth	20
,, Elec. cable	1,768
Port Elizabeth	63
Port Said	22
Rotterdam	45
,, Teleg. wire	18
Shanghai	625
,, Teleg. mat.	65
Singapore	167
Sydney	605
,, Elec. cable	1,990
Trinidad. Teleph. cable	86
Wanganui	25
Yokohama	1,052
,, Teleg. wire	62
Total	£24,005

Foreign Goods Transhipped.

Barbadoes. Teleph. mat.	Value £31
Fremantle. Elec. mat.	25
Iquique. Elec. goods	43
Total	£99

Auckland. Elec. apprts.	Value £547
,, Teleg. apprts.	285
Durban Elec. manufactures	25
Total	£857

Telephone Sketching Chart.—An ingenious chart has been designed, and is being issued by Messrs. W. T. Glover & Co., Ltd., of Trafford Park, Manchester, for the use of persons who wish to transmit sketches by telephone in cases of urgency; this novel proceeding is accomplished by means of sectional paper, with the ordinates and abscissæ numbered in order. The drawing to be transmitted is sketched down on the chart, and a description is written out giving the co-ordinates of the beginning and end of each straight line, the centre and radius of each circle or curve, and so on; this description is then read out and received by telephone, and from it the sketch can be reproduced on a corresponding chart at the receiving end, "by a clerk of average intellect." It will be seen that the principle of the method is one familiar to engineers, and there is no reason why any difficulty should be met with in putting it into practice; mistakes will almost certainly be immediately detected in the act of reproducing the design from the verbal description, and can be rectified by a further recourse to the telephone. In emergencies it is often important to reduce to the utmost the loss of time in transmitting a drawing, and by this method it would be possible to order a piece of mechanism or apparatus from a distant workshop in the afternoon and receive it next morning, instead of writing a letter and waiting for two days. The chart is the copyright of Messrs. Glover, to whom any inquiries respecting it should be addressed.

Bankruptcy Proceedings.—A sitting of the London Bankruptcy Court was held on August 3rd, before Mr. Registrar Gifford, for the public examination of Carl Vigant Tyge de Falbe, lately carrying on business as the Electrical and General Contracting Co., at 17, Shaftesbury Avenue, W.C. The statement of affairs shows gross liabilities £3,288 10s. 8d., of which £2,049 7s. 3d. is expected to rank against assets valued at £491 6s. 7d. In reply to Mr. C. A. Pope, Assistant Receiver, the debtor said he was of Danish nationality. His father formerly held the post of Danish Minister in this country. From 1894 to June, 1897, witness was engaged in the study of electrical engineering, and in December, 1896, he was made bankrupt. When at 25 years of age, under the Danish law, he came of age, he became entitled to his interest under his late father's will, and paid off the old debts with interest. That left him with about £10,000 or £11,000 in securities, which he deposited with bankers, and had since realised. In July, 1900, he commenced business at 17, Shaftesbury Avenue, W.C., under the style of the Electrical and General Contracting Co., with a capital of £1,000. He was then acquainted with Mr. C. M. Downie, who was in the employment of the Sir Hiram Maxim Electrical and Engineering Co., Ltd. An arrangement was made to form a trading company with a view to selling the incandescent lamps of that concern, and the Hiram Maxim Lamp Co., Ltd., was floated, witness acting as a signatory to the articles of association, also being appointed as a director at a salary of £150 per annum. As a commission for the introduction, witness was allotted £1,000 shares in the company, and he also acquired £3,500 shares for £1,750, which he raised on the shares and the securities left to him by his father. In September, 1901, he sold the office furniture and effects at 17, Shaftesbury Avenue to the Hiram Maxim Lamp Co., Ltd., for about £300, the idea being to amalgamate the two businesses. The amalgamation was not effected, and in November, 1901, witness executed a deed of assignment of his estate to a trustee acting on behalf of the creditors generally. Since then he had been without occupation, but had received £450 per annum derived from his life interest under his father's will in a sum of £10,000, the securities representing which were deposited with the Minors' Estates Office in Copenhagen. Witness attributed his insolvency principally to extravagance, to loss of trading at 17, Shaftesbury Avenue, and to loss in relation to his holding in the Hiram Maxim Lamp Co., Ltd. Although his income under his father's will was only £450, his expenditure had amounted to £800 or £900 per annum. The debtor was questioned by counsel on behalf of creditors, and eventually the examination was ordered to be concluded.

The creditors of Sir Kenneth Mackenzie, Bart., met by adjournment on August 3rd, at the London Bankruptcy Court, before Mr. G. W. Chapman, Official Receiver. Since succeeding to the family estates in Scotland, the debtor has been engaged either as director or consulting engineer to various companies with which Mr. H. J. Lawson was connected, and which dealt with electrical enterprises. His main assets consist of his interest in a Canadian canal company, from which he expects to receive about £20,000. The debtor attributes his present position to the action of one of his creditors in refusing to concur in the view of the majority to wait for their money until the work of the syndicate is completed. After considerable discussion the meeting was further adjourned for three months to enable the debtor to formulate and submit a proposal.

At Bangor Bankruptcy Court on August 4th, Frederick Wm. Parkes and Edward Sadleir, trading as Parkes & Sadleir, electrical fitters and engineers, at the Dingle, Colwyn Bay, came up for their public examination, on accounts showing gross liabilities, £108; assets, £25; deficiency, £83. Bad trade, absence of one of the partners in South Africa for 15 months, pressure by creditors, payment of costs on summonses, and loss on contracts, are the causes of failure. The debtors commenced business in 1901. Parkes served his apprenticeship with a Birmingham firm of electrical engineers, but Sadleir had had no previous experience. The latter provided the capital of £50, and in all had put over £200 into the concern. The examination was closed.

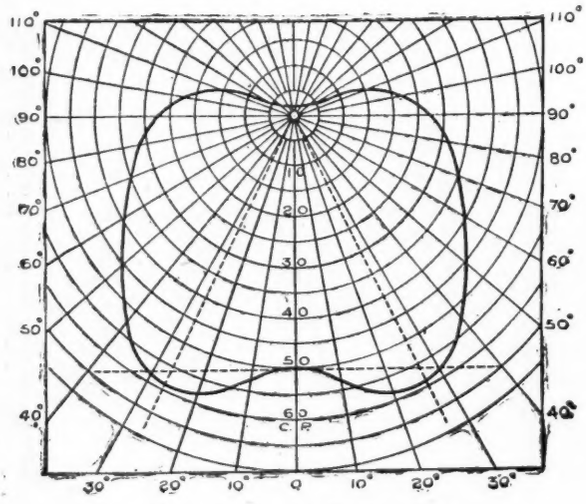
The statement of affairs in the failure of Harold Powell, electrical engineer, of the Strand Arcade, Derby, show unsecured liabilities amounting to £56 7s. 4d., and assets nil.

Trade Announcements.—Messrs. Smithson, Sharpe and Co., of Manchester, have appointed Mr. Alan G. Robson, 8, Eldon Square, Newcastle-on-Tyne, as their sole agent for the counties of Northumberland and Durham, and the towns of Middlesbrough and Carlisle.

The London Electrical Fittings Co., Ltd., of Roberts Works, Hampstead Road, N.W., wish us to point out that they have no connection whatever with the Electrical Fittings Co., who were defendants in a case reported in our "Legal" columns last week.

The Electric and Ordnance Accessories Co., Ltd., have appointed Messrs. J. and A. Anderson, 231, St. Vincent Street, Glasgow, as their representatives for Scotland, Messrs. Morris, Warden & Co., having ceased to act in that capacity.

The B.T.H. Meridian Lamp.—The British Thomson-Houston Co. send us particulars of their Meridian lamp, which is of a special type designed to fill the gap between the ordinary incandescent lamp and the arc lamp, but with the simplicity of the former and an efficiency approaching that of the latter, combined. The lamp is of the incandescent filament type provided with a large spherical globe and translucent prismatic reflector, and its appearance when burning is that of a globe of soft, brilliant white light. The effective distribution of the light can be judged from the accompanying diagram, from which it will be seen that the maximum candle-power is about 58, at an angle of 30° from the vertical, and that an average candle-power of about 55 is well maintained over an angle of 60 deg. The lamp is particularly adapted for ceiling suspension, and is not intended to be used on side brackets; it gives a uniform illumination of great intensity over a circular field beneath it, specially adapting it for use in drawing offices, libraries, shop-window illumination, &c. The standard Meridian lamp is made in only one size, giving 55 c.p.,



Light Distribution from Meridian Lamp.

and consuming 120 watts, and is supplied in voltages from 100 to 125 only. The bulb is spherical, 5 in. in diameter, and is always supplied frosted; the lamp fittings, which include a special holder, are supplied wired ready for use. The B.T.H. Co. have issued a pamphlet giving full particulars of these lamps, together with data regarding the most effective spacing and height, in order to secure different intensities of lighting.

Bitumen Contracts.—The Portsmouth and Pembroke contracts mentioned last week were ordered from Messrs. R. Carr and Co., by Messrs. Johnson & Phillips.

The Transvaal.—The value of the electric cable wire and fittings imported into the Transvaal during the four months ending with April last is returned at £22,000, as against only £20,000 in the first four months of 1903.

Book Notices.—"Duncan's Manual of Tramways, Omnibuses and Electric Railways." T. J. Whiting & Sons, Ltd., South Place, E.C. 5s.—The 1904 edition of this useful directory, which has now reached its 27th year, has been issued. The present edition has been re-arranged in alphabetical order of officials and professions, with a view to making it more useful for reference. The editor has a true appreciation of the importance of the subject of tramway renewals and depreciation, and he directs special attention to it in his prefatory note. The general particulars relating to the various undertakings include statements of capital at December, 1902 and 1903 respectively, the revenue accounts at the same dates, also passengers carried, mileage open, traffic receipts per mile run, and so forth.

"Universal Directory of Railway Officials, 1904." Directory Publishing Co., Ltd., Ludgate Circus Buildings, E.C. 10s.—With the subject of electrification of our railways so much to the fore, and with the prospect that the next few years will see some important advances in that direction, this directory is bound to become more valuable to the electrical man who wants to know who's who in the railway world. It has reached its 10th year, and is compiled from official sources by Mr. S. R. Blundstone, the editor of the *Railway Engineer*. The information is given wherever obtainable respecting the railway systems throughout the world, and practically all of the tramways worked by power in the United Kingdom are included. The directory is not purely personal, for it gives details of the equipments of the various systems.

"A Technological and Scientific Dictionary." Part IV. London: George Newnes, Ltd. 1s. net.

"Properties of British Standard Sections." No. 6 British Standard Sections issued by the Engineering Standards Committee. London: Crosby Lockwood & Son and the Committee. 5s. net.

"Transactions of the North-East Coast Institution of Engineers and Shipbuilders." Vol. XX. Parts 7 and 8. Session 1903—1904. Newcastle-upon-Tyne: The Institution.

"Text-Books of Physical Chemistry: Electro-Chemistry, Part I., General Theory." By R. A. Lehfeldt, D.Sc. London: Longmans, Green & Co. 5s.

"Fire Tests with Partitions.—No. 84, A Partition formed with Jabez Thompson's Patent 'Terrawode' Brickwood." London: The British Fire Prevention Committee. 2s. 6d.

The Wages of Pattern-Makers.—At the meeting of the Wolverhampton Town Council on Monday, a discussion took

B.T.H. Meridian Lamp.

place respecting the wages paid by Messrs. Thomas Parker, Ltd., to the pattern-makers in their employ. Some time ago a contract for certain electrical work at the Corporation Refuse Destructor was given to Messrs. Parker, and the Trades Council entered a complaint on the ground that the firm did not pay their pattern-makers the standard rate of wages, 34s. per week, and that therefore they would, in executing the contract, violate the fair wages clause. A lengthy correspondence between Messrs. Parker and the Electricity Committee was read, inwhich the firm admitted that young pattern-makers were receiving 28s., 30s., and 32s. per week, and that they were working their way up to 34s. It was contended by the Trades Council that when their objection was first made, the firm immediately withdrew the patterns necessary from their own men, and had them made elsewhere. In the result, it was decided to ask the firm where the patterns were made, who made them, and whether the sub-contractor paid the standard wages or their equivalent.

Dissolutions and Liquidations.—At a meeting of Ferranti, Ltd., held at Manchester on July 29th, a resolution was passed to wind up voluntarily with Mr. J. M. Henderson, 2, Moorgate Street Buildings, E.C., as liquidator.

At a meeting of Refuse Destructors, Ltd., held at Dashwood House, E.C., on August 4th, it was resolved to wind up voluntarily with Mr. F. H. Firth, of that address, as liquidator.

Messrs. W. H. Heath and J. J. Reynolds (Electrical Power Engineering Co., Birmingham) have dissolved partnership.

The first meetings of creditors and contributories of Shippey Bros., Ltd., electrical engineers, King Street, E.C., are to be held on August 19th, at Carey Street, W.C.

Mr. Justice Farwell, in the Chancery Division on Wednesday in a debenture-holders' action of Anderson *v.* the London Electromobile Syndicate, Ltd., appointed a receiver and manager of the defendant company's undertaking, plaintiff holding £200—which had become due—out of an issue of £966. The receiver was empowered to act at once. Mr. Baker appeared for the plaintiff, and Mr. Owen Thompson for the company.

The Price of Rubber.—The *Financial Times* says that in an interview with a prominent rubber merchant in Berlin a representative of the *Tageblatt* has been informed that the large increase in the price of raw materials commenced about two years ago. The quotation for Para rubber, which amounted to 2s. 10d. per pound at the end of 1902, advanced to 3s. 9½d. in December last, and at present it stands at 4s. 11d. per pound, or almost twice the rate obtaining two years ago. "The reason for this advance is not due to a scarcity of the material, as the production has slowly in-

creased, but it is solely attributed to manipulation on the part of the English raw rubber merchants. There are ten prominent firms on the English market who completely dominate the market, and who maintain prices on a high basis. To some extent these firms, the Berlin representative is further reported to have been informed, seek to produce an artificial scarcity of material by the accumulation of stocks, especially at Liverpool."

Catalogues and Lists.—Messrs. Ferranti, Ltd., have issued several new catalogues. No. 5 describes and illustrates their alternating-current switchboard integrating type of wattmeter, provided with a polished aluminium case, with nickel plated fittings and mounted on an enamelled slate base. No. 4 is a price list of current transformers for integrating wattmeters, and No. 6 deals with potential transformers for wattmeters, voltmeters, synchronisers, relays, &c.

Messrs. Dyer & Young, of Stansted, have published a circular detailing their "Advance" motor starters and controllers. It is claimed that the starters comply with the most stringent insurance requirements; that the live parts are protected from dust or damage, while the contacts are all within view through the glass strip in the cover; and that if the lock-up case is used no unauthorised person can interfere with the starter. Slow speed motor (open and enclosed) starters with combined circuit breakers are described, and tables of prices are given.

A list of "Alexandra" injectors and ejectors has come to hand from Messrs. W. F. Dixon & Co, of C.-on-M., Manchester.

We have received from Messrs. Meldrum Bros, a souvenir describing the new destructor and sewage works which were opened last month by the Epsom U.D.C. The destructor is of Meldrum's simplex regenerative front-fed type. Another pamphlet contains a reprint of Mr. W. F. Goodrich's paper on "The Disposal of Institutional and Trade Waste," read before the Folkestone Congress of the Royal Institute of Public Health.

Messrs. E. F. Moy's latest list relates to quick-break knife switches.

The British Uralite Co., Ltd., have just published a catalogue showing a variety of neat designs for ceilings made of their uralite fireproof material.

Messrs. Siebe, Gorman & Co., of Neptune Works, S.E., have sent us copies of several new lists. One relates to their air pump with drying apparatus as used in telephone and electric lighting work; and another to self-contained submarine electric hand lamps for divers.

Messrs. Cutting Bros., Ltd., of Derby, are circulating a card of prices for electric motors.

In a new pamphlet issued by Messrs. Chamberlain and Hookham, Ltd., of Birmingham, the Hookham patent prepayment meter is described and clearly illustrated.

The A.E.G. English Manufacturing Co., Ltd., to whose new arrangements we referred last week, have now brought out their illustrated catalogue of "Aegma" Nernst lamps, showing several types, including the Luna, Express, A. B. & C. types, and accessories and watertight fittings for same.

Electrical Machinery in Collieries.—Messrs. Ernest Scott & Mountain, Ltd., of Newcastle-on-Tyne, have recently secured some further important contracts for their electric machinery for colliery service. The Mickley Coal Co. has ordered a complete electrical transmission plant for the Mickley Colliery near Stocksfield-on-Tyne; the contract includes two sets of horizontal coupled compound slow-speed engines of 360 effective H.P. each, and two direct-current generators, each of 270 KW., mounted on the engine crankshafts, and running at a speed of 110 r.p.m. The contract also includes a booster, a 150-H.P. main and tail-haulage gear complete with friction clutches and electric motor, and two electric widing gears, together with the main and branch cables, main and distributing switchboards and starting switches, and smaller motors for smith's shops, &c., at bank. The Lambton Collieries, Ltd., have ordered for the Littletown Colliery, near Durham, an electrical pumping plant consisting of a quadruple centrifugal pump to deliver 350 gallons of water per minute against a head of 250 ft., this pump being driven by one of Scott and Mountain's multipolar electric motors of 66 effective H.P., running at a speed of 1,220 r.p.m., the motor being placed between the pumps—*i.e.*, a series of two pumps being placed at each side of the motor. The same firm are also supplying for the colliery a 30 effective H.P. electric motor for driving an existing haulage gear, and a complete arrangement of motor-room switchboards and cables. The Globe Phœnix Gold Mining Co., which has its mines in Rhodesia, has ordered from Messrs. Scott & Mountain one of their latest types of three-phase alternating-current generators of 112 KW. capacity (which will be driven by the company's existing steam engine at the mine), together with one of their three-throw mining pumps, which will deliver 170 gallons of water per minute against a vertical head of 1,000 ft., complete with a three-phase induction motor of 40 effective H.P., switchboards, cables, overhead equipment, starting switches, &c. Messrs. Scott & Mountain have had upwards of 15 years' experience in coal-cuttiing work, and have lately designed a disk machine suitable for working in thin seams, the height of the coal-cutting machine being 14 in. This machine can be made to work on rails or skids, the total height from the floor to the top of the machine when on rails being 22 in., and when mounted on skids 20 in. They at present have in hand coal-cutting machines for Hamsterley Colliery, Shilbottle Colliery, Old Silkstone Colliery, near Barnsley, Messrs. Newton, Chambers & Co., Sheffield, and others.

Steam Dryers and Oil Separators.—Messrs. Holden and Brooke, Ltd., have, we understand, just received a repeat order from their South African representatives, Messrs. Hannam, Hill & Co., for two large oil separators for the Witwatersrand Gold Mining Co., Johannesburg. One No. 12 separator is to be capable of dealing with 7,200 lbs. of exhaust steam per hour, and the other (No. 23) to deal with 24,000 lbs. of exhaust steam per hour. They inform us that they have been particularly busy with their other specialities, amongst recent orders for Brooke's patent steam dryers and traps being the following electricity stations:—Sedgeley U.D.C., Halifax, Harrogate, Southampton, Capetown, Liverpool, Goole, Kensington and Knightsbridge, Newcastle and Hastings; also the Admiralty, India Office, Royal Arsenal, Dick, Kerr & Co., Singapore tramways, Tokio tramways, Malta tramways, &c.

Raworth's Traction Patents.—The Barrow-in-Furness Tramways Co. have placed an order for two Demi-cars with Raworth's Traction Patents, to be equipped with the automatic regenerative control. A novel feature in connection with these cars will be introduced for the first time. They will be tested complete in the works before dispatch, and will be sent completely equipped, ready for service the day they are delivered at Barrow.

Plant for Sale.—Bristol Corporation is offering for sale two Lancashire boilers, six Siemens alternators (88 and 210 KW.), and a 52-KW. Siemens-Willans direct-current set, &c. Particulars are given among our advertisements to-day.

Electrically-Illuminated Railway Rolling-Stock.—The East Coast railway companies (the Great Northern, North-Eastern, and North British railways) have at last decided to follow the example of their rivals on the West Coast (the London and North-Western and Caledonian companies), and also the Midland Railway Co., in equipping their latest type of rolling-stock with the electric light; we understand that several of the luxurious dining-cars used on the East Coast Scotch expresses are now being fitted at the Doncaster works of the Great Northern Railway with electric lights, fans, &c.

LIGHTING AND POWER NOTES.

Belfast.—The city electrical engineer, Mr. V. A. H. M'Cowen, has reported that for the six months ending June 30th last, the output has exceeded a million units, and the income received was £13,887, as compared with £11,940 during the corresponding period of 1903. The average price per unit was 2·767d., as compared with 3·066d. in the previous year.

Calcutta.—Complaints are being made against the high rates charged for energy, *i.e.*, 4 annas per unit for fans, and 8 annas per unit for lighting. The Calcutta Electric Supply Corporation has the exclusive licence to supply electricity under the local authority, and it is contended that the Corporation could pay a substantial dividend after making a big reduction in the rates, which would result in many more consumers being connected.

Cardiff.—The Electrical Committee of the T.C. has recommended the Corporation to include in its next Parliamentary Bill powers to hire out motors.

Carnarvon.—The T.C. has received sanction from the L.G.B. to borrow £17,315 for E.L. purposes. The tender of Messrs. Heenan & Froude to erect the generating station at a cost of £2,900 has been accepted, on the understanding that they employ local labour and complete the works within 10 weeks after commencement.

Continental Schemes.—Spain.—A concesssion has been granted to utilise the power of the River Serondi, at Proaza, for electrical purposes.

Italy.—A company is being formed to install the electric light in the towns of Casaletto Spartano, Sapri, Torraca, and Vibonati. The municipalities of Modene, Taleggio, and Vadeseta, have applied for concessions to utilise neighbouring water powers for electrical purposes. A company is in course of formation at Lucca for lighting the town by electricity.

France.—An electricity works is about to be erected at Sallans (Jura).

Crewe.—The T.C. has received sanction to raise a loan of £4,500 for additional plant at the electricity works.

Dewsbury.—The accounts of the Corporation's electricity works for the year ending March 31st last show that, on the year's working, there was a net profit of £1,009, against an adverse balance of £92 last year. The works costs amounted to £2,918, as compared with £1,602 for the previous 12 months. The revenue from the sale of energy amounted to £8,575, as against £5,173, and for meter rents, &c., £189. The increase in the consumption of energy is due to the supply taken by the Yorkshire (Woollen District) Electric Traction Co., £2,734 of the amount received for energy being for tramway purposes.

Dumfries.—The T.C. on 4th inst. agreed to send to the India-Rubber, Gutta-Percha, and Telegraph Works Co., Silvertown, a draft of the agreement by which it is proposed to transfer the undertaking authorised by its prov. order. The agreement stipulates that the company shall pay to the Council £620 as the amount of expense incurred, £80 as fees for engineers' expenses, and a yearly

sum of £30 for an annual inspection by the Council's engineer. The Council agrees to purchase the site, and that the company shall pay £100 per annum as rent. The Council also reserves the right to purchase the undertaking at any time after the expiry of 7½ years. The maximum prices to be charged for energy supplied to private consumers, are 7d. per unit for lighting, and 3d. per unit for power.

Dunedin, N.Z.—The County Council is making application for a water-race, 8 miles in length, to obtain the power of a river in the vicinity for generating electricity for tramway and other purposes. The race is estimated to cost £6,000.

Exeter.—The T.C. has reduced the price of energy from 6d. per unit to 5d., and meter rents from 10s. to 5s.

Gloucester.—The City Council has instructed its electrical engineer to prepare a scheme for extensions at the electricity works, comprising a 600-KW. set, boilers and auxiliary plant.

Honley.—The U.D.C. has deferred for a year the question of lighting the streets by electricity.

India.—The Rangoon Municipal Committee has resolved to adopt, on the Local Government's recommendation, the alternating-current system for the electric lighting of the district. Major I. de Lotbinière, R.E., was consulted in the matter, and urged the adoption of this system in consideration of the future extensions of the town. Major de Lotbinière, it is stated, will visit Kashmir to advise the Durbar in connection with an electric power scheme in the State.

Leigh.—The borough surveyor has submitted plans for the extension of the electricity works at an estimated cost of £2 430, and these have been approved. Tenders from the G.E. Co. and Messrs. W. Boydell & Sons, Leigh, for the supply of motors have been accepted.

Leyland.—The B. of T. has informed the U.D.C. that it has extended the period for carrying out the prov. order for electric lighting for a year from July 23rd.

Little Hulton.—The U.D.C. has given consent to the Lancashire Electric Power Co.'s application, to supply energy for power and lighting within the Council's area.

Marlborough.—The T.C., which recently decided to apply for a prov. order for electric lighting, has opened negotiations with the Marlborough Electric Supply Co., which is seeking similar powers.

Maidstone.—The result of the last year's working of the Corporation electricity undertaking, ended March 31st last, shows a gross profit of £2,508, against £1,472 for the previous 15 months. Interest and sinking fund absorbed the sum of £3,783, leaving a deficiency, chargeable to the General District Rate, of £1,275. Expenditure on capital account amounted to £9,390 during the year. £356 remained in hand at the end of the previous year, and a loan of £7,106 was obtained; £552 was expended on motors for hire, thus the capital account is overspent by £1,382 The increase in public lamps amounted to 38½ per cent., and private consumers' lamps increased by 47 per cent.

Neath.—The Corporation has resolved to borrow £2,000 for electrical purposes.

Oldham.—A loan of £48,114 for electricity purposes has been applied for by the T.C. Of this sum £31 964 is for money overspent, and the balance is made up of £15,000 for mains, £850 for cable ducts, and £300 for machine tools.

Otago, N.Z.—An interesting electrically-operated dredge has been recently working at Alexandra, South. The source of energy is a fall on the Fraser River, and by means of a 2 ft. pipe the water power is supplied to a turbine direct-coupled to a three-phase alternator of 200 KW., running at 400 r.p.m., with a pressure of 5,000 volts. The energy is transmitted by a pole line of about three miles to the dredge, and is transformed down on board to 250 volts for use on the motors, and to 50 volts for lighting the plant by means of arc lamps. A 100-H.P. motor drives the buckets, pump, screen, silt wheel, and elevator through a shaft running the full width of the dredge, and a 20-H.P. motor drives the winches.—*Australian Hardware and Machinery.*

Oulton Broad.—A private company having intimated that it intends applying for a prov. order for electric lighting, the U.D.C. has decided, in the interests of the town, to seek similar powers.

Provisional Orders.—The Southern District Electricity Corporation intends to apply for a prov. order to supply electric light to Great Marlow. Mr. G. V. Fowler has informed the Trowbridge and Farnborough U.D.C., and the Llantrisant and Llantwit Vardre Council that he will apply for E.L. prov. orders covering these districts. An order for the electric lighting of Coalville is to be applied for by the Mutual Electricity Supply Co. The Empire Electric Light Co. will endeavour to obtain a prov. order to supply electricity in the Berkhampstead U.D.

Redditch.—On August 1st a L.G.B. inquiry was held into the application of the U.D.C. for a loan of £26,000 for the extension of the E.L. undertaking. Opposition was offered by the gas company.

Spalding.—The U.D.C. has decided to take steps to obtain a prov. order for electric lighting, with a view to preventing private companies from obtaining similar powers.

Stourbridge.—A L.G.B. inquiry was held last week into the application of the U.D.C. for sanction to borrow £4,000 for electrical purposes. In April last the Council asked the L.G.B. to sanction a loan of £16,000 for erecting a generating station, &c., but the Council was advised to consider an alternative proposal to purchase electricity in bulk from the Midland Electric Corporation, whose mains run up to the northern boundary of the U.D. This has been done, and the loan required reduced to £4 000. The agreement with the Midland Corporation has not yet been completed, but it is proposed that a flat rate of 1·5d. be charged for power, and 2·55d. for electric lighting, with discounts. The inspector intimated that the Board would not sanction the loan until it had the agreement in a completed form.

Surbiton.—The U.D.C. decided on 8th inst. to increase the electric lighting plant by a third boiler and engine at an estimated cost of £4,400.

Walsall.—The Electricity Committee has recommended that, in addition to the existing charge of 6d. and 2d. on the maximum demand system, with discounts of from 10 to 12½ per cent., for lighting, a flat rate of 4d. per unit, without discounts, should be adopted. It is computed that by this alternative price a saving of £950 would accrue to consumers.

Wednesbury.—The T.C. has decided that meter rents be not charged to consumers of electricity where accounts amount to £1 per quarter, and that, if desired by consumers, electricity will be supplied for the outside lighting of shops either by arc or large Nernst lamps at a flat rate of 4d. per unit, such lamps being connected to a separate meter, and on condition that electricity only is used inside the premises.

West Australia.—The agreement entered into between Fremantle and East Fremantle Councils and Messrs. Noyes Bros., of Sydney, for the installation of electric tramways and lighting services, provides that the latter will design the scheme and superintend the construction at a commission of 10 per cent.

West Bromwich.—A L.G.B. inquiry was held on the 3rd inst. into the application of the T.C. to borrow £1,300 to defray the cost of laying a main in Spon Lane. It was stated that the extension was decided upon in consequence of a large firm making application for a supply for power purposes. There was no opposition.

TRAMWAY AND RAILWAY NOTES.

Batley.—A Committee recommends the acceptance of the tender of the British Westinghouse Co. for the supply of a steam dynamo and accessories for the electricity works. The new plant will be needed for meeting next winter's demand.

Burton-upon-Trent.—Mr. P. J. Pringle, the borough electrical engineer and tramways manager, has issued a report on the first 12 months' working of the tramways, which terminated on 8th inst.:—The total receipts were £18,528 1s. 10d.; the car-mileage 433,739. The traffic receipts per car-mile were 9·97d., and the total receipts per car-mile 10·25d. The total passengers were 3,987,900, or 9·19 per car-mile. Traffic receipts per passenger, 1·084d. Of the total units, amounting to 558,997, 540,191 were used for driving the cars, or 1·28 per car-mile. The population was carried 76·7 times. A number of special expenses incidental to the starting up of the tramways have been charged through, and the operating expenses, which were 7·57d. per car-mile at the end of the first eight months, are reduced to 6·9d per car-mile at the end of the 12 months. The net surplus on the year was £2,000.

Dundalk.—It is expected that the electric trams will be running to Blackrock next spring, and that the equipment for the electric lighting of the town will be laid down this year. A railless tramway is contemplated, overhead wires and trolley-pole motor-buses being employed.

Glasgow.—At the last meeting of the Corporation, in reply to the question as to whether he would have prepared a statement showing (1) the earnings per car-mile within the city boundary, and (2) the earnings per car-mile without the boundary, Mr. Paton, the convener, said he could not give such an undertaking. A return of the character desired would be misleading. Notice of motion on the lines of the question was given. In moving the adoption of the minutes of the Tramways Committee, Mr. Paton said that the Committee had agreed to ask the authority of the Corporation for covering 100 tramcars for service in the city. The Committee had not unduly hurried the question, and had shown several types of covered cars working on the streets. In order that all the routes in the city should share the new cars, the Committee also asked authority to lower the roadway under bridges where at present there was not room for the cars to pass. The adoption of the new cars would more than double the carrying capacity, and they would be a great convenience to the public. Mr. D. M. Stevenson said that, on account both of appearance and of health, the covered cars were most objectionable, and sooner or later the T.C. would regret the step they had taken. He suggested that the

appearance of the cars would be improved by the introduction of the double-bogie car.

The T.C. has instructed the town clerk to intimate to the Board of Trade that, in terms of Section 18 of the Paisley District Tramways Order, of 1901, the Corporation proposes to exercise the running powers granted to it over the portion of the Paisley District Co.'s track from Hawkhead Road to Paisley Cross, and the Corporation, having failed to agree with that company with regard to the exercise of said running powers, will ask the Board of Trade to nominate an arbiter to determine (1) what payment shall be made by the Corporation to the company in respect of said running powers and for electric energy, and (2) to what conditions and regulations the Corporation shall be subject. Paisley T.C. and the tramways company have been informed of the decision.

Great Western Railway.—The half-yearly report says:—"The electrical generating station at Park Royal and the other works in connection with the electrification of the Hammersmith and City line are being pushed forward as rapidly as circumstances will permit. The directors are continuing to extend the use of motor-cars on the railway, and are satisfied with the results which have attended the experiment they have made with road motor-cars."

London, Tilbury and Southend Railway.—Mr. John Warren told the shareholders at the half-yearly meeting last week, that with regard to the question of electric traction, the directors recognised that it would be necessary for the proper development of the traffic that this system of traction should be installed as an alternative means of working from the point where the Whitechapel and Bow Railway joined the Tilbury Railway at Campbell Road, Bow, to a point at or near Barking. Accordingly steps were being taken with the object of adapting this portion of the railway for electric traction, so that it might be ready for use at the time when the new mode of working was brought into operation on the Metropolitan and District Railways. They fully hoped to get the electric system in operation as far as East Ham in the early part of next year—when the District Co. would be ready for it.

Manchester.—The Corporation seal was on Tuesday ordered to be affixed to an agreement with the Bucklow Rural District Council (which includes Northenden, Dunham Massey, and Timperley), dealing with the proposed new lines in Cheshire. Under the agreement the Corporation takes over the powers granted by Parliament under the Manchester Southern Tramways Act, and undertakes to construct lines which, in the case of Timperley and Dunham Massey, are to revert to the local authority in 35 years, and in the case of Northenden (including Northen Etchells) in 42 years.

Newcastle-on-Tyne.—On the 4th inst. a meeting of the Finance Committee of the Corporation was held, at which reference was made to the reports relating to the tramways, which had been drawn up by the City Treasurer and the City Auditor. It was decided simply to report to the Council that no provision had been made in the estimates prepared by the Tramways Committee for a depreciation fund, so that the whole matter will be thus brought up before the Council.

Newport (Mon.).—A scheme for granting bonuses to drivers having been considered, the following has been adopted:—Drivers.—A bonus of 5s. per quarter to each driver whose car has been free from accident due to fault of driver, during that period. Conductors.—For largest amount of fares taken per quarter on each route, First prize, 10s.; second prize, 5s. On the recommendation of the tramways manager, it was decided to place two special clocks for registering the times when the tramways employés go on and off duty, at the car-sheds, Corporation Road, at a cost of between £60 and £80.

North-Eastern Railway.—In his address to the half-yearly meeting on the 5th inst., Viscount Ridley said that of the £221,000 for rolling stock, the cars for the electric service at Newcastle cost £140,000. The cost of the electrification of the lines was £98,000. Including the electric trains, the passenger mileage had increased by 65,000 miles. The whole of the electric system in the Newcastle district had been opened. From the point of view of traffic, it had been very satisfactory, but the novelty of the system had caused them to be beset with a great many difficulties, which—though they were surmounting them gradually—were real difficulties—difficulties both as to the safety of workmen and passengers and the convenience of the latter. Although it was very early to speak of profit and loss of the undertaking, 53,402 train-miles were run in the half-year up to June 30th, at a cost of £4,911. By way of comparison he pointed out that the bookings during the week ended July 9th last and the corresponding week of last year had increased by 25 per cent. and the money by 22 per cent.

The Proposed Berlin—Hamburg Railway.—The Prussian Minister for Railways has invited the Berlin Allgemeine Co. and the Siemens & Halske Co. to send representatives to attend a conference to be held at the Railway Ministry at the end of August for the purpose of discussing the question of establishing a high-speed electric railway between Berlin and Hamburg, which towns are separated by a distance of 177 miles. Both companies have elaborated projects for the building of the line, and these were submitted to the State railway authorities some time ago, with suggested speeds of from 100 miles to 125 miles an hour. Now it is reported that the General Electric Co., of New York, has also entered the lists, and has offered to construct the railway and equip it for a speed of 125 miles an hour. Although there is little hope of the American company being successful in its attempt, it is possible, as a result of the friendly relations and agreements existing between it and the Berlin Allgemeine-Union Co., that the New York company would be prepared to co-operate with the latter, if asked to do so, in the execution of the scheme. But the Prussian Railway Minister is placed in a dilemma. He is not disposed to undertake the responsibility of constructing the railway as a State line, even if he could secure, which is doubtful, a vote by the Diet of from £5,000,000 to £6,000,000 for the purpose. On the other hand, the Minister is not likely to approve the erection of a new line which would divert traffic from the existing State railway between Berlin and Hamburg, although it is whispered that, if the promoters would indemnify the State against any loss of traffic, they might be sure of a more sympathetic reception of their proposals. As the promoters are of opinion that the undertaking of any such obligation would be fatal to the financial success of the scheme, there would appear to be a kind of deadlock between the State railway authorities and the two electrical companies. However that may be, the impending conference will probably throw further light on the question, which has assumed considerable prominence owing to the present action of the Minister, who has hitherto held aloof from this particular railway project, in consenting to discuss the subject with the promoters of the rival schemes, which are founded upon the experimental results obtained on the military railway between Marienfeld and Zossen.

Pudsey.—The T.C. has resolved to apply for a prov. order, enabling the Corporation to construct and work electric tramways within the borough.

Wednesbury.—At last steps are being taken by the Corporation to amicably settle several questions in dispute between the lessee company and the South Staffordshire Tramways Co., which otherwise will involve prolonged and costly litigation. Until these questions are disposed of there is little likelihood of the electrification of the steam tramways.

TELEGRAPH AND TELEPHONE NOTES.

Action against the Postmaster-General.—In the Chancery Division on Wednesday Mr. Justice Farwell had before him a motion in the matter of Lowndes *v.* the Postmaster-General, in which Mr. Cassidy, on behalf of the defendant, moved to set aside the writ on constitutional grounds. Mr. Upjohn, K.C., for the plaintiff, said the cause of the action was this:—The Postmaster-General, who is a body corporate and the happy possessor of all the telegraph poles in the kingdom, had put up a pole on his private property. He contended that the Postmaster-General was the right person to sue. The plaintiff's position was a serious one, inasmuch as there was the terrible penalty of £20 a day for anybody who interfered with the telegraph system of the country. It was a case of alleged trespass. Plaintiff had, therefore, called the attention of the Postmaster-General to the fact by a letter written to him personally, and with regard to the continuance of the trespass on his part. Plaintiff's case was that there were quite sufficient authorities to show that the defendant was liable for the acts of his subordinate servants. On the suggestion of his Lordship, Mr. Cassidy consented to the appearance of the Postmaster-General without prejudice, and the hearing was fixed for November next.

Bengal Telephones.—In connection with the new telephone system of the Bengal Telephone Co., Ltd., a telephone cable of the latest type was laid under the river at the Howrah Bridge, in July. The new system is to be practically an underground system, which will then render the telephone wires free from all atmospheric disturbances. The cable was made by W. T. Henley's Telegraph Works Co. The existing cables between Calcutta and Howrah are to be replaced.

Bournemouth Telephones.—As a result of a canvass made by the Telephones Committee of the Council, it is proposed to apply for a municipal licence.

Foreign Telephones.—In the House of Commons recently, Lord Stanley informed Sir T. Dewar, M.P., that, since April, 1902, orders amounting to about £109,000 had been issued for the equipment of telephone exchanges in London, most of which were given to a foreign firm which held numerous patents for the central battery system. Circumstances are gradually altering, and it was hoped that before long it would be possible to obtain telephones for the use of subscribers from British makers only.

The Telephone Question.—In the Commons on 8th inst., in answer to Mr. Weir, Lord Stanley said he was still in negotiation with the National Telephone Co., and while it was undesirable to make any statement as to the nature or terms of the arrangement under discussion. "Having regard to the date which we have reached, I shall certainly not be in a position to make any communication to the House on this subject before the end of the present Session; but if an agreement is arrived at it shall, as I have already promised, be laid before Parliament before it becomes binding, in order that the House may have an opportunity of considering it."

Swansea Telephones.—The manager of the Corporation Telephone system reports that 939 lines and instruments are working, and 175 orders are still incompleted.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Dakar-Konakry	May 13, 1904	
Chio-Ténédos	June 21, 1904	
Paramaribo-Cayenne	July 13, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1904	
Malta-Tripoli	Aug. 3, 1904	Aug. 4
Landlines.		
Seoul-Masampo	Feb. 18, 1904	
Seoul-Gensan	Feb. 18, 1904	
Anju-Ping-Yang	Feb. 25, 1904	
Ninguta-Vladivostock	March 2, 1904	
Moulmein-Bangkok	July 13, 1904	
Irkoutsk-Pekin	Aug. 2, 1904	Aug. 4
Caimanera-Santiago	June 15, 1904	
Fao route	Aug. 3, 1904	Aug. 4

Wireless Telegraphy.—The *Elektrotechniker* states that the Austrian Telegraph Administration proposes to install a wireless telegraph station on the third floor of the new central offices in Vienna. This station, which will be established in about a year, will enable the Government engineers to practically follow the progress made in wireless telegraphy. The Slaby-Braun-Siemens system will be employed, as the Marconi system is much more costly to install. The Vienna station will only be in communication with two other stations, established at Leopoldau, eight kilometres from Vienna, as the crow flies, and at Kreutzenstein, 15 kilometres distant. In order to experiment on longer distances, it is proposed to erect another station in the vicinity of Vienna. It is also stated that the Austrian Minister of Commerce has asked the Marconi International Co. to suggest a device for grouping the three wireless stations which will be established on the coast of the Adriatic, viz., at Opcina, near Trieste; at Pcren, the southern point of Istria; and on the island of Lissa. These three stations will communicate *vid* Otrante and Gibraltar with the English wireless stations.

Reuter reports that the wireless telegraphic service between the stations of Bari and Antivari was inaugurated on 3rd inst. Signor Marconi was at the Antivari station, and the Marquis Solari at the Bari station.

It is reported from Madrid that the Spanish military authorities in the case of experiments made with portable field installations have succeeded in the transmission of messages in mountainous country over a distance of 80 miles by the use of the German "Telefunken" system. One of the stations for the purpose was established in Madrid, whilst the second was erected at Arevalo *vid* the Sierra Guadarrama. Notwithstanding the wooded mountainous district, about 2,000 metres high, it was possible to exchange telegrams without any faults arising, and it is, therefore, considered that the definite introduction of the German system in the Spanish army now seems assured. The experiments were followed by the King and a number of officers of high position.

The *Daily Telegraph* says that the Government have decided to establish a wireless telegraph station on the Marsden, some three miles from South Shields. The site for the signal station will be selected on the edge of the cliffs, which command a view north and south for miles along the coast. The new station is primarily to be used for communication with passing warships.

CONTRACTS OPEN AND CLOSED.

OPEN.

Dublin.—August 23rd. 500 alternating-current meters. See "Official Notices" August 5th.

Hove.—August 30th. Low-pressure mains, conduits, meters, &c. See "Official Notices" to-day.

Leeds.—August 15th. Two 1,000-KW. turbo-alternators with condensers, exciters, and high and low-pressure switchgear. See "Official Notices" July 22nd.

London.—October 4th. Three electric car traversers for the L.C.C. See "Official Notices" August 5th.

London.—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

Manchester. August 30th.—Wiring and electric lighting of transit sheds at the New Dock Works. See "Official Notices" July 29th.

Penang.—August 16th. Steel rails, permanent way material, trolley poles, wire, feeder pillars, &c. See "Official Notices" July 29th.

Perth.—August 16th. 4¾ miles of tramways for the Corporation: permanent way, paving, and bonding, overhead equipment, cables, ducts, &c., cars and equipments, car depôt building. See "Official Notices" July 22nd.

Plymouth.—August 15th. (1) Steam alternator; (2) Lancashire boilers with accessories. See "Official Notices" July 15th.

Plymouth.—August 15th. Firms desirous of tendering for an electric light installation at the Technical School, Plymouth, for the Plymouth Education Authority, can inspect plans, &c., at No. 11, The Crescent, Plymouth.

Roumania.—August 27th. Tenders are being invited until the 27th inst. by the Roumanian State Railway Authorities in Bucharest for the supply and erection of the additional plant required for the supply of electrical energy for lighting and power purposes at the new railway workshops in that city.

Santos (Brazil).—August 20th. Power house plant consisting of producer gas plant and gas-driven alternators of a total of 400 KW., and transformers. See "Official Notices" July 22nd.

Wakefield.—August 15th. The Wakefield and District Light Railway Co. is inviting tenders for stores, tools, &c., for one year. See "Official Notices" August 5th.

Warrington.—August 16th. Cables and stoneware conduits for the Corporation. See "Official Notices" August 5th.

CLOSED.

Batley.—The T.C. has placed an order for a steam dynamo and accessories with the British Westinghouse Electric and Manufacturing Co., Ltd.

Brighton.—The T.C. has accepted the tender of the British Westinghouse Co. for a switchboard at the Southwick power station for the support of extra high-pressure switchgear, at £1,291.

Bristol.—The Corporation electricity department has given a contract for two 500-KW. motor-generators, Peebles-La Cour patent, to Messrs. Bruce Peebles & Co., Ltd.

Bromley.—The B.C. has accepted the tender of Messrs. Godfrey (£634), being the lowest, for the installation of electric lighting plant at the refuse destructor works.

Burton—Ashby—Swadlincote.—The Midland Railway Co. have entrusted Messrs. Dick, Kerr & Co. with the contract to construct rather more than 10 miles of light railway, linking up Burton-upon-Trent, Ashby de la Zouch and Swadlincote. The main roads are being followed with the exception of a short length, where sleeper construction will be used. The work will be carried out to the drawings and specifications of Messrs. Chas. H. Gadsby and Co., the company's engineer.

Calcutta.—The A.B.P. Accumulator Co., Ltd., has secured an order for 230 cells of its standard S4 11-plate type for shipment to Calcutta.

Carnarvon.—The T.C. has accepted the tender of Messrs. Heenan & Froude, for the erection of an E.L. generating station, at £2,900.

Colchester.—The T.C. has accepted the tender of Messrs. Joslins, Ltd., for wiring 40 houses and 10 shops under the prepayment meter system.

Dewsbury.—The T.C. has accepted the tender of Messrs. J. & J. Horsfield, of Dewsbury, for a Lancashire boiler at the electricity works, at £620. It was objected that this was not the lowest tender.

Folkestone.—The T.C. has accepted the tender of Messrs. Smith & Co., of Folkestone, for E.L. fittings for the Town Hall, at £157 9s.

Fulham.—The B.C. received the following tenders for two boilers capable of evaporating 14,000 lbs. per hour, for the electricity works:—

Stirling Boiler Co., Motherwell, N.B.	(accepted)	£2,600
Babcock & Wilcox, Ltd., Renfrew, N.B.		2,680
Richardsons, Westgarth & Co., West Hartlepool		2,966
R. Hornsby & Sons, Grantham		2,978
B. R. Rowland & Co., Redditch		2,995
Stirling Co. (American), Manchester		3,391

The Council has also accepted tenders for the supply of coal as follows:—

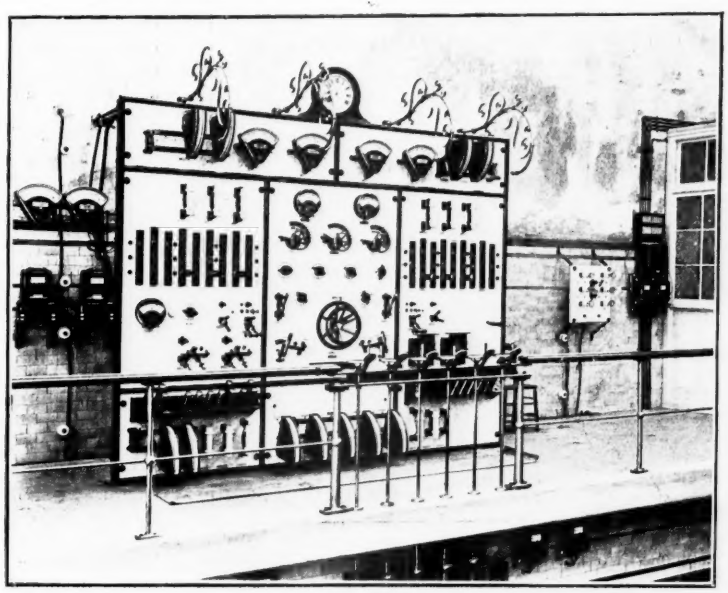
2,000 tons of Shirebrook double screened nuts, at 12s. 6d. per ton, from Messrs. Firmston & Co., of Putney.
1,000 tons of "Crynant" Welsh nuts, at 14s. 9d. per ton, from Messrs. Charrington, Sells, Dale & Co.
1,000 tons of "Albert" nuts, at 11s. 11d. per ton, from Messrs. Charrington, Sells, Dale & Co.
The same to be delivered as and when required, in barges alongside wharf at Townmead Road generating station.

Gloucester.—The City Council has accepted the tender of Messrs. Mather & Platt, for the supply of the filtering plant for the electricity works, at £192.

(*Continued on page* 264.)

LEEK ELECTRICITY WORKS.

On June 9th of this year the Leek Urban District Council formally opened its electricity generating station, and the supply was commenced. As the plant is of small capacity, and is driven by town gas, a short description of it will doubtless prove interesting as representing a possible solution of the problem of lighting small towns.

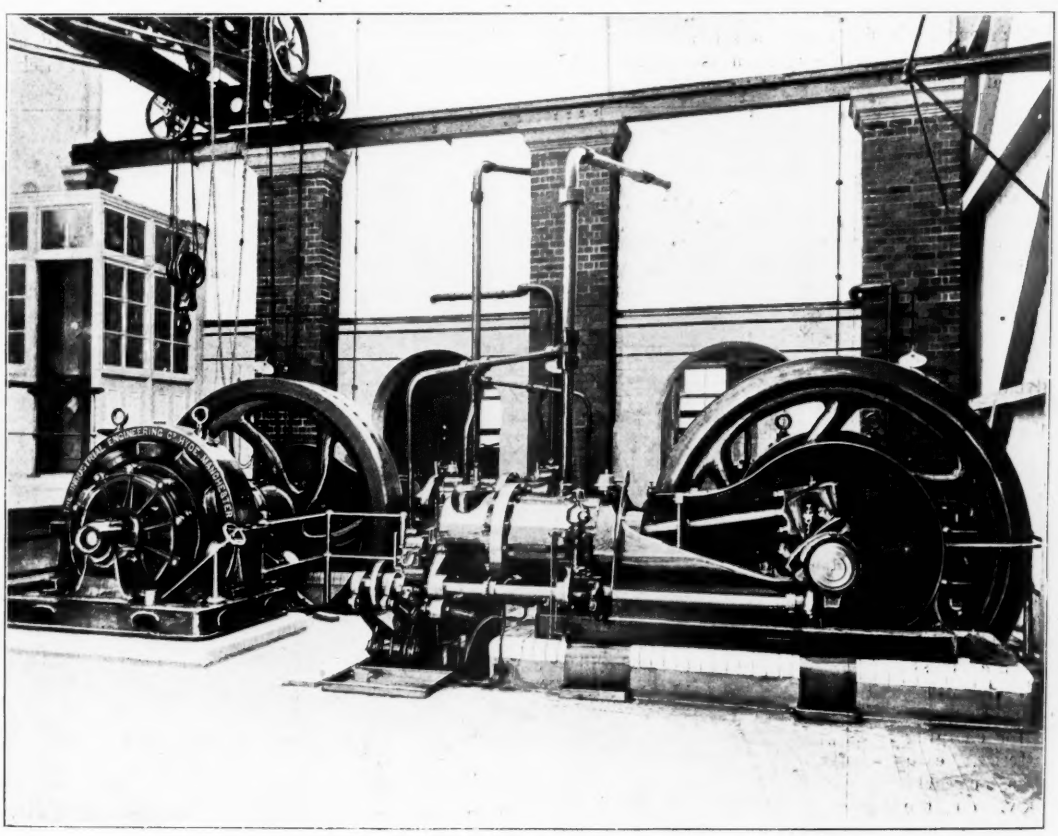


Main Switchboard.

The works are situated upon a piece of land owned by the Council, known as the Town's Yard, in Crusoe Street, and having the advantage of being at no great distance from the centre of the town. The erection of the buildings was commenced in June 29th, 1903, the work being carried out by Mr. Wm. Turner, contractor, of Leek, to the specifications of Mr. John Taylor, architect.

The buildings are divided into two blocks. On the left of the entrance gates are the store room, workshop and test room; these are separated from the main building by an open space and roadway for the admission of goods, &c. The main building consists of the engine room, motor room, battery room, and the engineer's office.

The engine room, with the switchboard gallery at one end, measures 39 ft. × 37 ft., and is 24 ft. high from the floor to the lowest part of the iron roof principals. The walls are faced to a height of 10 ft. with glazed tiles and moulding, the remaining part being plastered. At present only half of the engine room is utilised, the other half being laid with a wood floor upon bearers. The room is adequately lighted by means of large lanterns and skylights running the whole length of the roof, and is spanned by an overhead travelling crane by Messrs. Carrick & Ritchie, of Edinburgh.

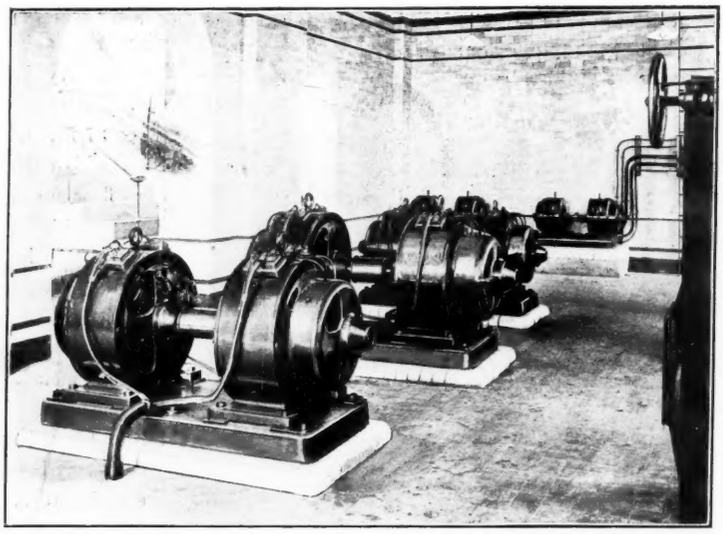


Generating Plant.

The motor room measures 37 ft. × 17 ft., having two openings leading into the engine room. Above this room is fixed a water tank measuring 15 ft. × 10 ft. × 4 ft. 6 in.

deep for cylinder cooling purposes. The floor of the tank room is formed of concrete and steel joists.

The battery room measures 42 ft. × 16 ft., and is 12 ft. high; this is also lighted by means of lanterns and skylights running the full length of the room. The floor is laid with falls, and consists of acid-proof asphalte.



Leek Electricity Works:—Balancer and Boosters.

The generating plant in the engine room consists at present of two "Stockport" horizontal single-cylinder gas engines, each capable of developing 100 H.P., coupled direct by means of flexible couplings to two 60-KW. dynamos, supplied by the Industrial Engineering Co., of Newton, Hyde. Each engine is fitted with a specially heavy fly-wheel and self-starter, and the ignition is electrical, and fitted in duplicate. The engines are governed both by the throttle, and by a hit-and-miss governor. The gas supplied is from the Council's gas works at gas-holder pressure, being regulated at the generating station by a special governor fixed in the motor room. The dynamos are shunt wound, of the multipolar type, and are fitted with carbon brushes.

A balancing transformer is fixed in the motor room, and is capable of dealing with an out-of-balance current of 80 amperes. The field windings are cross-connected.

Two boosters are provided for charging the batteries, each having a capacity of 6 KW. on the generating side, and giving an E.M.F. of from zero to 130 volts. Each machine is driven by its own motor at 460 volts. At the end of the motor room, next to the battery room, two motor-generators are provided for milking and testing purposes. The milking machines are operated from a separate switchboard let into the wall of the battery room, upon which are provided the necessary switches, starting resistances, &c.

In the battery room are provided two batteries of 128 cells each, 21 of which are used as regulating cells, having a capacity of 300 ampere-hours. The regulating cells are connected to the switch contacts by means of bare copper rod supported upon the wall by porcelain insulators. The specified rate of discharge is 60 amperes for 5 hours, with a maximum discharge of 120 amperes for one hour. The battery was supplied and erected by the A.B.P. Accumulator Co., of Stockton-on-Tees.

The switchboard consists of eight panels of white marble mounted upon a steel angle framework, and finished off with enamelled iron moulding. Upon each of the outer panels, on the front of the board, are provided: two single-pole feeder fuses, one single-pole battery fuse, one single-pole chopper switch for the balancing transformer, one single-pole minimum and reverse current automatic cut-out for the booster generator, and nine copper bars fixed vertically for connecting the dynamos, feeders, battery, booster, and balancer to the three bus-bars fixed horizontally at the back of the panels, by means of plugs. On the positive or right-hand panel, in addition to the above, two B.T.H. automatic maximum current circuit-breakers are fixed, and on the negative panel two single-pole main dynamo switches are provided, interlocking with which are the shunt breaking switches. A switching-in voltmeter and switch contacts are also fixed upon this panel.

Upon the centre panel the starting switches for the balancing transformer and the boosters are mounted, also the battery emergency switches, and change-over switches, the latter being linked with the booster shunt switches. The middle wire bar is fitted at the foot of this panel, and is supplied with three plugs, connecting the balancer and batteries to the middle wire, as required.

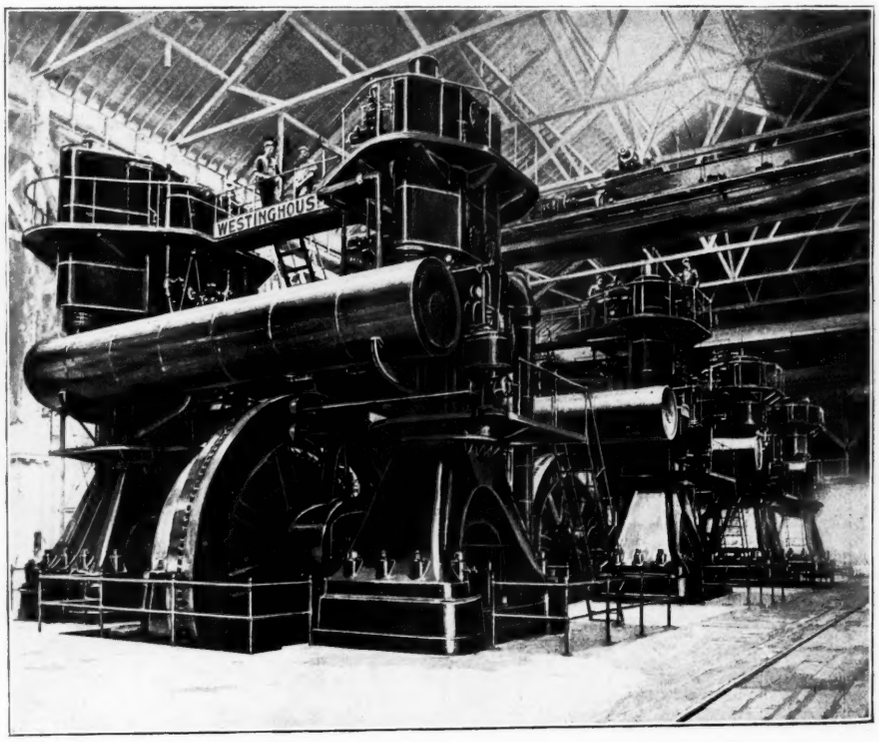


Fig. 1.—Westinghouse Steam Alternators at St. Louis.

Upon each of the outer panels at the top of the board are fixed the feeder ammeters, and above the centre panel one dynamo voltmeter, one bar voltmeter, and two battery voltmeters are mounted, being controlled by switches upon the centre panel.

Upon each of the outer panels at the bottom of the board the fuses for the balancer, booster motor, and booster generator are fixed, and upon the negative lower panel the two dynamo ammeters are fixed in addition.

Upon the centre panel at the bottom of the board the battery ammeters, booster motor ammeters, and one polarised ammeter connected to the middle wire are fixed. The "earth" connection is made through an ammeter to a separate earth-board, mounted upon iron wall-brackets and connected to a water main in the street.

Two concentric handwheels are mounted upon the centre of the switchboard for the purpose of cutting in and out of circuit the regulating cells of the battery, by means of chain geared battery switches.

The feeder voltmeters are mounted upon a hinged bracket fixed to the left-hand side of the board; the whole of the voltmeters have illuminated dials. Space is provided for an additional dynamo and another feeder connection. Ampere-hour meters are provided for the dynamos, batteries (charge and discharge), and for each of the booster motors.

The whole of the switchboard and copper rod work was supplied and erected by Messrs. Crompton & Co.

The town is supplied by two feeders 940 yards and 370 yards respectively, and 2,300 yards of distributors. Pilot leads are brought back from each of the feeding points to the station. The whole of the mains are paper-insulated cables sheathed in bitite and drawn into stoneware conduits, the feeders being twin concentric ·15 and ·05 respectively, and the distributors triple concentric ·08, ·04, ·08 sq. in. The pilots are 3-core 7/20 S.W.G. At present mains are laid only in the principal streets, but applications having been received from numerous side-streets, the Council is considering the question of extending the area of supply considerably.

The whole of the plant was designed and put down to the specifications of the consulting engineers, Messrs. Burstall & Monkhouse, and was erected under the supervision of the Council's resident electrical engineer, Mr. R. M. Carr.

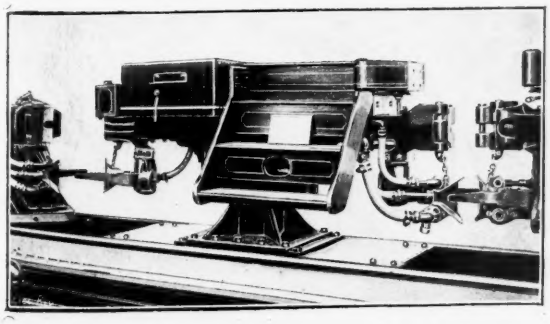


Fig. 4.—Working Model of Westinghouse Automatic Couplers.

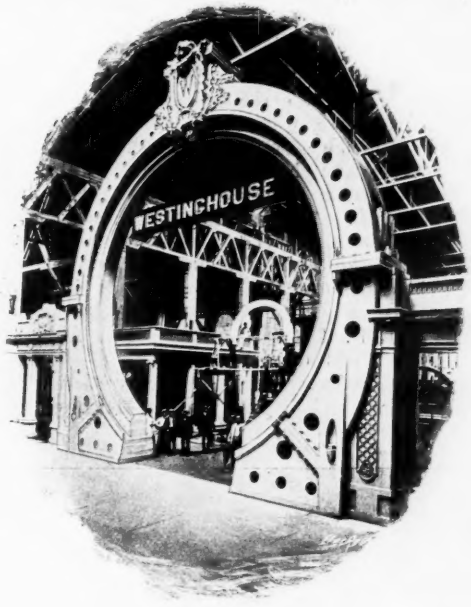


Fig. 3.—Armature Arch Entrance to the Westinghouse Exhibit in the Machinery Hall.

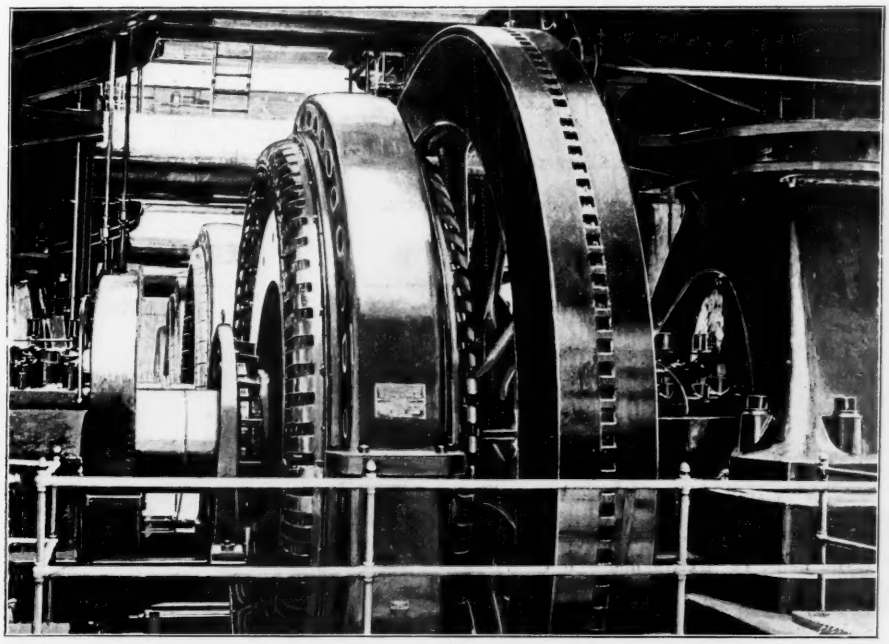


Fig. 2.—Westinghouse Generator, forming part of one of the Sets Shown in Fig. 1.

THE LOUISIANA PURCHASE EXPOSITION.

The Westinghouse Companies' Exhibit.

The main service generating plant at the Louisiana Purchase Exposition, for which the Westinghouse Electric and Manufacturing Co. received the general contract, is naturally the most notable item of the Westinghouse exhibits, and the four 3-phase generating units—each of 2,000 kw. capacity — which are provided for this purpose, being situated in the central aisle of the Machinery Hall, form a very prominent feature therein.

A general view of the Westinghouse-Corliss engines and alternators of which this plant consists is given in fig. 1, and a view of one of the generators in fig. 2. These sets run at 83·5 r.p.m., and the current is generated at 6,600 volts pressure and 25 cycles frequency. These generating units are

each almost three times the size of the sets which the Westinghouse Co. installed at the Chicago Exhibition of 1893, which were of 750 KW. each, 12 in number, and together constituted the largest polyphase plant working in those days. Large as are the sets at St. Louis, they are but small compared with the 5,000 KW. alternating-current Westinghouse generators built for the elevated and subway train service in New York City, and the 10,000 KW. Westinghouse generators now being constructed for the Ontario Power Co. A full-size (35 ft.) plaster model of the stationary armature of one of the above mentioned 5,000-KW. sets forms a striking entrance arch to the Westinghouse exhibit in the Machinery Hall. This is shown in fig. 3.

The space occupied by the units at St. Louis amounts to about 35 × 15 ft. of floor area, their height being 32 ft., and the fly-wheels 23 ft. in diameter.

The total space devoted to the service electric plant in the Machinery Hall, including the exciter units, condensers,

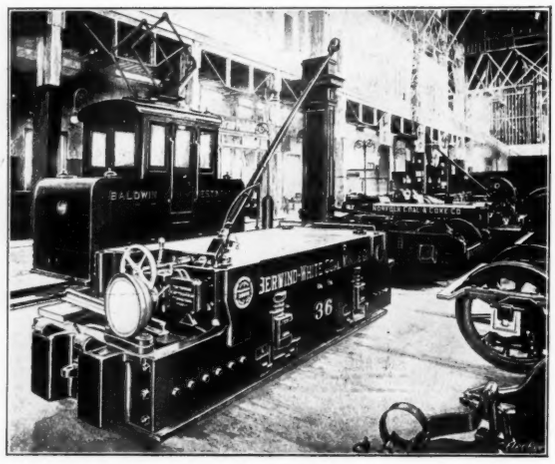


FIG. 5.—ELECTRIC MINING AND SWITCHING LOCOMOTIVES.

cooling towers, and the 35-panel switchboard, is 26,260 sq. ft. The entire steam and electric station was designed and equipped by Messrs. Westinghouse, Church, Kerr & Co., all the generating machinery and the steam plant in the adjacent boiler house being furnished by the Westinghouse Machine Co. The service plant, although within the Westinghouse walls at the west end of the Machinery Hall, has not been laid out with any special view to exhibition.

The various organisations associated with the name of Westinghouse have an additional area in the Machinery Hall of 26,260 sq. ft.; in the Palace of Electricity, an area of 10,100 sq. ft.; and in the Transportation Building, an area of 3,000 sq. ft. The total exhibit area amounts to 65,620 sq. ft., which is nearly 10 times the space occupied by the same interests at the Pan-American Exposition at Buffalo in 1901. The manufacturing companies associated in these joint exhibits employ an army of 30,000 employés, and occupy a total workshop floor space of over 140 acres—more than is found in all of the 12 great exhibition palaces of the St. Louis Exposition.

In the Machinery Hall, in addition to the electric service plant and the main exhibit of Westinghouse gas engines, turbo-generators, rotary converters, exciting dynamos, and motors in operation, which are all enclosed within ornamental walls and columned entrances of classic design, is the Westinghouse auditorium. This will seat 350 persons, and here biograph and mutoscope pictures of scenes in and about the various Westinghouse works in the Pittsburg district are

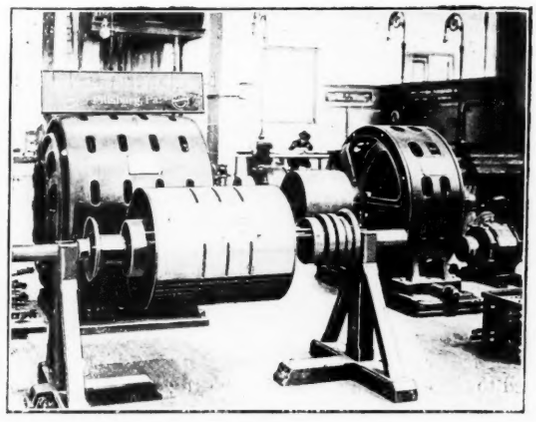
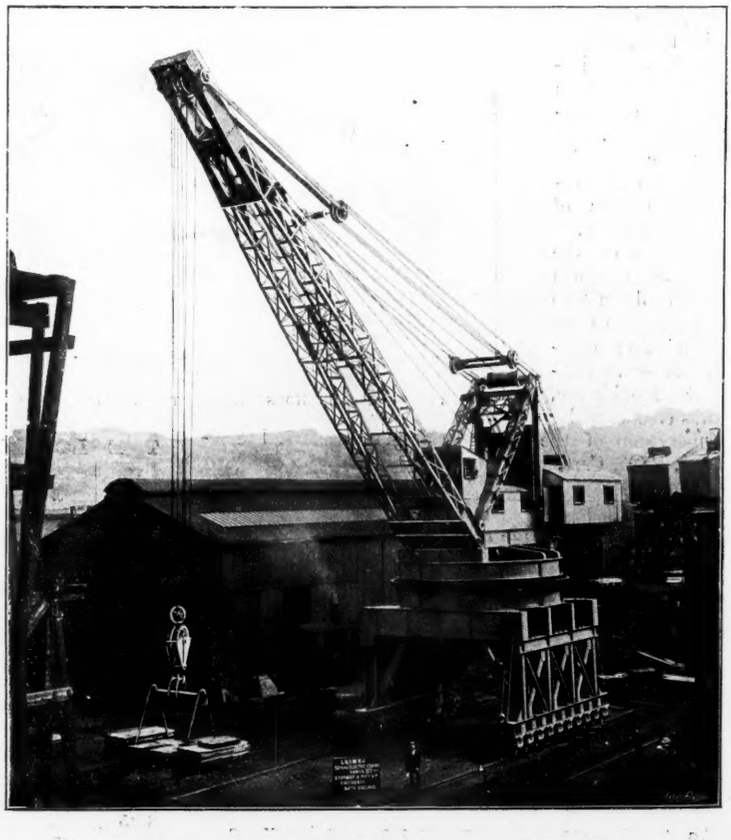


FIG. 6.—FIELD-MAGNET AND ARMATURE OF A 400-KW. WESTINGHOUSE TURBO-ALTERNATOR.

displayed at frequent intervals each day. The auditorium, which is of ornate architectural design, is rendered cool and comfortable by a ventilating system which provides a continual supply of pure air, and is brilliantly lighted with Sawyer-Man incandescent lamps, Bremer arc lamps, Cooper-Hewitt mercury-vapour lamps, and Nernst glowers; all of which are also used extensively throughout the other portions of the Westinghouse display. Besides the purposes enumerated above, the Westinghouse auditorium is also available as a meeting place for scientific societies and technical congresses. The Cooper-Hewitt lamps, by the light of which the Westinghouse mutoscope shop views were taken, form one of the distinct novelties at the Exhibition, and several forms of such, as designed for use in general illumination, photography, and photo-engraving, are shown. Cooper-Hewitt lamps are also in use in various other exhibits.



50-TON ELECTRIC CRANE BY MESSRS. STOTHERT & PITT, LTD.

There are in all about 10,000 Nernst lamps in use in the Exhibition buildings, 6,000 of them being in the Fine Arts Museum. In service or on exhibition the Westinghouse Co. have installed altogether some 14,000 H.P. of generating machinery, and 30,000 H.P. of motors and other appliances.

Steam for the service plant is piped from a large battery of Babcock & Wilcox water-tube boilers built into a single setting, and having a total capacity of 6,400 H.P. The auxiliary electrical plant includes three 80-KW., 125-volt direct-current direct connected exciters.

The exhibit service plant includes a 400-KW. Westinghouse-Parsons steam turbine generating set, which runs at a speed of 3,600 r.p.m., and delivers a three-phase 60-cycle current at 440 volts. It is the smallest turbine unit built by the Westinghouse Machine Co., and a number now nearing completion are of 7,500 H.P. capacity. The plant also comprises a 125-H.P. vertical, and a 250-H.P. horizontal Westinghouse gas engine, the first being direct connected to a standard D.C. generator, and the second to a standard three-wire, double voltage D.C. generator. Gas engines up to 3,000 H.P. are now under construction in the Westinghouse shops.

An important part of the Westinghouse installation which is seen by few is the pumping machinery under the cascades in front of the Festival Hall. This equipment consists of three large centrifugal pumps, each driven by a 2,000-H.P. Westinghouse induction motor, and it supplies 90,000 gallons of water per minute for the cascades; these motors are probably the largest of the kind ever constructed.

In the Palace of Electricity, the Westinghouse Electric and Manufacturing Co. occupies a space of over 10,000 sq. ft., 1,000 sq. ft. of which are devoted to the display of electric trucks and locomotives constructed in conjunction with the Baldwin Locomotive Works. A general view of a portion of this exhibit is given in fig. 5. Two locomotives built for mine service are shown, one weighing 20,000 and the other 30,000 lbs., and each being equipped with two 500-volt No. 79 motors. Another 20,000-lbs. locomotive, for switching, is equipped with two No. 75 motors. In the regular electrical equipment display there is a 400-KW. turbine type generator (fig. 6), typical generators, transformers, motors, switchboard apparatus, instruments of precision, and innumerable other appliances and accessories. The single-phase series-wound crane motors, and the new Westinghouse unit switch system of multiple control, are also shown in this section.

The combined exhibit of the various Westinghouse Brake Companies includes single-phase railway motors, the successful production of which constitutes one of the most important electrical developments of the last two years.

The Westinghouse Traction Brake Co.'s exhibit consists of the well-known magnetic brake and car-heating equipment, and the straight air brake for both motor-driven and axle-driven compressors. The magnetic brake is applied to a truck running on a track 45 ft. long, the truck being fitted at both ends with friction draught gear buffers to show the use of this extensively adopted device.

The Westinghouse Automatic Air & Steam Coupler Co. exhibits the ends of two freight cars fitted as movable models, to show the operation of the coupler in actual practice. This also is shown on two small models fitted with air and steam and signal couplers (fig. 4). Under this model is another working model of the magnetic brake.

The Union Switch & Signal Co.'s exhibit includes examples of electrical appliances for the operation and control of signals, and a signal designed for use in the tunnels of the Pennsylvania Railroad under the Hudson River to New York City, this being fitted in a full-size model of one of the tunnel tubes. The company's most important exhibits at St. Louis, however, are the installations in actual service, chief of which is the Westinghouse electro-pneumatic interlocking system at the big Union Station, which controls all of the passenger yard movements, and is much the largest interlocking apparatus ever built.

In the city of St. Louis are 1,000 street cars equipped with Westinghouse air brakes, driven by Westinghouse motors, and operated from stations in which are installed Westinghouse generators with a total capacity of 20,000 H.P.

A 50-TON ELECTRIC CRANE FOR SOUTHAMPTON GRAVING DOCK.

MESSRS. STOTHERT & PITT, LTD., of Bath, have recently completed for the London and South-Western Railway Co. an electrically-operated crane of exceptional size and power, of which we give a view on the opposite page. It has been built at their Victoria Yard on the banks of the Avon, and its lattice work jib, towering far above surrounding buildings, has called the attention of Bath people to its remarkable dimensions. It is intended for lifting heavy machinery and other burdens requiring considerable power at the new graving dock at Southampton; while it has been temporarily put together at Bath for testing purposes, it will be taken to pieces and re-erected on the ground it is to permanently occupy at the southern port. There it will be the subject of final tests, but the machine has been already operated in the presence of Mr. Drummond, the chief locomotive engineer of the London and South-Western Co., and was, we are informed, on that occasion satisfactorily worked with an overload of 25 per cent. On August 3rd further trials were made, the Mayor of Bath (Major Simpson), several railway and dock engineers, and other visitors having accepted the invitation of the manufacturers to inspect it in operation. On this occasion a load of 40 tons of thick slabs of iron was attached to the hook, and with this weight, hoisting, slewing, and derricking were performed with the greatest ease and with silence.

The crane has been designed as well as constructed by Messrs. Stothert & Pitt, and has been built under the superintendence of Mr. Drummond. It is electrically driven throughout, each motion being provided for by a separate motor. The electrical equipment throughout has been supplied by the Allgemeine Elektricitäts-Gesellschaft, of Berlin, and Mr. J. G. W. Aldridge, of Victoria Street, London, inspected the electrical part of the installation on behalf of the railway company. The crane is designed to deal with 50-ton loads, with the jib at such an angle that in revolving the crane, the circle described by it has a radius of 87 ft. When engaged in this operation the jib is at an angle of 22° from the horizontal, and the complete revolution can be accomplished with the full load in 2½ minutes. The load test to which the crane has been subjected under these circumstances is 70 tons. By raising the jib, the radius can be reduced to a minimum of 47 ft., and in this position the load may be lifted nearly 100 ft. above the rail level. When thus raised the jib is at an angle of 15° from the vertical. The derricking gear is powerful enough to raise the jib with the maximum load, and the change from the full radius to the minimum can, under these circumstances, be effected in 7 minutes. The lifting speed with full load is 16 ft. per minute. There is, however, a quick gear for lighter weights, capable of hoisting 56 ft. per minute.

The crane runs on 20 central-flanged steel-tired wheels on a twin track, the gauge of which is 25 ft. 6 in. The base, from first to last wheel, is 30 ft. long. Every axle bearing is fitted with four volute springs on each side of the running wheels, the weight being thus distributed over 160 springs in all. The driving gear at the ground wheels is of Messrs. Stothert & Pitt's special type, and is made to compensate for the play of these springs. The under truck is of massive construction, and is strongly braced in all directions; it follows the essential principles of the Titan cranes made by this firm. On this truck the upper part of the crane revolves on a live ring 25 ft. 6 in. in diameter, on 44 conical steel rollers. The circular rack through which the revolution is effected has 240 teeth. The jib is light in appearance, and consists of twin booms of open braced lattice work. Each of the booms is composed of four main angles, and is cross-braced at the ends and the middle. The principal dimensions of the crane are given in the following list:—

Gauge	25 ft. 6 in. between rail centres.
Clearance under truck cross girders	15 ft. 0 in.
Diameter of roller path	25 ft. 6 in. centres.
Wheel base	30 ft. 0 in.
Length of jib	85 ft. 0 in.
Height of jib-head from ground level at maximum radius	60 ft. 0 in.
Height of jib-head from ground level at minimum radius	103 ft. 0 in.
Height from rail level to circular rack	23 ft. 0 in.
Height from rails to top of king post	56 ft. 0 in.
Radius from centre pin to centre of tail ballast	32 ft. 0 in.

The derricking ropes are 12-part, 5½ in. in circumference, reeved double, two parts leading from the derrick barrel, which is grooved right and left-hand. The lifting ropes are six-part, 4½ in. circumference, reeved double, two parts leading from the lifting barrel, which is also grooved right and left. All these ropes have a factor of safety of eight when dealing with the maximum load.

The crane house is divided into three sections. The back part contains the lifting and derricking crabs with their motors; the centre, the slewing and travelling gear with motors, controllers and resistances. The front portion of the house consists of an elevated cabin for the driver, in which are all the operating levers. The position of the cabin gives an extremely extensive out-look for the driver in all directions, especially as the cabin is glazed on four sides.

Current is taken from ground connection boxes by a length of flexible cable connected to the junction box fitted upon the inside of the crane truck, whence it is carried by cables through the centre

pin, the top of which is fitted with a collector of the usual type. Distribution is effected from a switchboard in the driver's cabin by a separate circuit to each motor and controller. The motors are as follows:—

Lifting motion	...	Two motors, each of 50-B.H.P., with series-parallel controller.
Derricking motion	...	One 80-B.H.P. series motor.
Slewing motion	...	One 25-B.H.P. series motor.
Travelling motion	...	One 50-B.H.P. series motor.

All the motors are completely enclosed, and are designed to run on a 480-volt continuous current circuit.

Machine-cut spur gear is used throughout for all first and second reductions, with the exception of the first reduction of the derrick motion, for which a worm and wheel is utilised. Both the lifting and the derricking gear are fitted with solenoid magnetic brakes in series with their respective motors and connected to the first contacts of their respective controllers. In addition to these magnetic brakes, a mechanical foot brake is provided for lowering the load and a brake for checking the slewing motion. The derricking gear is provided with special frictional plates, which come into contact when the radius is being extended, thereby preventing any tendency of the jib to run out. These frictional plates are fitted on the end of the worm spindle, and are operated by ratchet and pawl, being automatically thrown out of action when the jib is being raised. The whole of the first reduction derrick gear is enclosed and runs in oil.

The brakes are so arranged that failure of the current automatically ensures the load being held at a standstill. The net weight of the crane is 250 tons; to this has to be added 70 tons of ballast in concrete blocks, so that with the load the total weight is approximately 375 tons.

Mr. Pitt presided at a luncheon provided in one of the workshops after the inspection; it was one of those rare occasions when speech-making was barred.

CONTRACTS CLOSED.

(*Continued from page* 258.)

Leigh.—The Tramways and Electricity Committee has, on the recommendation of Mr. G. F. Metzger, consulting engineer, accepted the following tenders:—

General Electric Co., 350-kw. steam-driven generating set ..	£2,213 10
Messrs. G. J. Statter & Co., switchboard	1,038 18

Lincoln.—The T.C. has been recommended to accept the tender of Messrs. Griffiths, Bedell & Co. for the construction of the permanent way of the tramways in the High Street.

Salford.—The T.C. has accepted the tender of Messrs. Heap & Co., Manchester, for wiring Pendleton Town Hall for the electric light, at £345 0s. 6d.

Southampton.—The Electricity Committee has accepted the tender of the Wheeler Condenser & Engineering Co. for a steam-driven condenser, at £560, and the tender of Messrs. C. A. Parsons & Co. for a steam balancer, at £2,000.

Walsall.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for a water-tube boiler and fittings for the electricity works, at £1,060.

Warrington.—The T.C. has accepted the tender of Messrs. Robert W. Blackwell & Co., Ltd., for certain overhead tramway equipment, at £738.

Whitby.—The U.D.C. has accepted the tender of Callender's Cable and Construction Co., for cables, at £648; and of the Cable Accessories Co. for joint boxes and compounds, for £97.

Wigan.—The Corporation E.L. and Tramways Committee has accepted the tender of the Lancashire Dynamo and Motor Co., Ltd, for the supply of a balancer, battery, booster and switchboard.

Wolverhampton.—The T.C. has given a contract to Mr. Herbert Holloway to construct the extended tramway track on the Wednesfield Road, for £2,753.

FORTHCOMING EVENTS.

Wednesday, August 17th to 24th.—At Cambridge. The Annual Meeting of the British Association for the Advancement of Science. President: The Rt. Hon. A. J. Balfour, M.P. The titles of some of the papers to be read before the "Engineering Section" were given in our issue of July 29th.

Machinery Designs Committee.—The Admiralty has appointed a Standing Committee on Machinery Designs. Prof. A. B. W. Kennedy, LL.D., F.R.S., has lent his services to the Admiralty and will act as President of the Committee. The other members will be Engineer Rear-Admiral J. A. Smith, and Mr. J. T. Milton, chief engineer surveyor to Lloyd's Register.

NOTES.

Electricity in Mining.—At the annual excursion of the Mining Institute of Scotland, which took place on Saturday to the Houldsworth Pit of the Dalmellington Iron Co., Ltd., Mr. Wm. Smith, general mining manager, read a paper descriptive of the work at Houldsworth pit The ppaer detailed the electric power plant just started, which consists of a Parsons steam turbine, coupled direct to a continuous-current dynamo, and gives an output of 200 kw. at 500 volts, and 3,500 r.p.m. The electric current is conveyed to the pit bottom by vulcanised rubber-insulated cables armoured with two layers of galvanised wire.

Street Explosions.—In the House of Commons on 9th inst., Sir T. Dewar asked Lord Stanley whether he was aware that, during the two years ended June 30th last, the metropolitan police reported 21 explosions, resulting in injury to 11 persons and the death of two horses, caused through leakage in an electric wire coming into contact with escaped gas. Would he state how many of these explosions occurred in the streets of the metropolis in connection with telegraph and telephone plant, and to what extent the persons injured had been compensated? Lord Stanley, in reply, said that he was quite unable to admit that any of the accidents could have been caused by the leakage of electricity from telegraph or telephone wires. There had been several explosions of gas in the street boxes belonging to the Post Office, but in none of these had it appeared that the Department was liable to pay compensation. Some of the recent cases were under investigation with a view to ascertaining the true cause of the explosions.

South African Notes (from our Durban correspondent):—*Johannesburg* (*Transvaal*).—The work of laying the rails for the Johannesburg tramways will soon be commenced; 3,500 tons of rails have been landed at Delagoa Bay, and a shipment of sleepers from Java is shortly due.

Pietermaritzburg (*Natal*).—The Natal Government Telegraph receipts for the year ending June 30th, 1903, amounted to £70,062, being a decrease of £35,087 on the previous year. The privilege of allowing the Imperial Military authorities free telegraphic traffic up to the value of £1,500 per annum has now been modified, all such messages being paid for at half the ordinary rate. By the discontinuance of the Morse recorder during the past 12 months, the work of maintenance has been reduced in addition to the saving in tape.

Work in connection with the Pietermaritzburg tramways is proceeding with all speed, and it is hoped to have the chief portion running by the end of August. The track is about complete, and the trolley work is now in hand, while a few of the cars are about ready for running.

Durban (*Natal*).—The acting borough electrical engineer in his report for the month ending June 30th, says that the 800-kw. engine alternator has been erected during the past month, and is now in use. The borough electrical engineer (Mr. J. Roberts) cabled from England on the advisability of adding a battery to the power station so as to cope with the large demand. The tender being £4,000, this was approved of by the Town Council.

French Flattery of Germans.—A correspondent writes:—"Although the future relations between the Paris municipal authorities and the electric lighting companies in the French capital are uncertain, especially in regard to the probable attitude of the former on the expiration, in a few years, of the concessions under which the companies work, it will come as a surprise to many to learn that the Prefect of the Seine has actually addressed a request to the Berlin Allgemeine Co. to submit schemes and estimates of costs and income for the construction of central stations in Paris. The company intends to comply with this flattering request, although it can only with difficulty, as a Berlin newspaper suggests, calculate upon receiving consideration in the matter of orders from the city of Paris on the building of the proposed central stations for the municipality."

The Inspection of Boilers.—A boiler made 32 years ago recently exploded at Cork, and it came out in evidence that there had been no inspection of it. The plates were wasted away to such an extent that the boiler was unfit for any pressure above that of the atmosphere. Great damage was done, but fortunately for the owner no lives were lost, or his position might have been serious. Boiler owners who will not pay for competent inspection, run great risks of being charged with manslaughter.

Gas Companies and Electric Lighting.—Col. Sir W. T. Makins in his address to the half-yearly meeting of the Gas Light and Coke Co. last week, said that the Electric Lighting Bill promoted this Session by the St. Marylebone Borough Council was opposed by the company, both as a ratepayer and as a gas company, and he was glad to say that they had succeeded in the House of Lords in getting a clause inserted which afforded the desired protection. The clause obtained was, they believed, an improvement on the well-known Bermondsey clause, inasmuch as it contained a provision which would prevent the Borough Council from making up any loss it might sustain in supplying electricity to private customers by charging the ratepayers a high price for the supply to public lights. The gas companies had no desire, as had been alleged, to cripple the purveyors of the rival illuminant; they only desired to receive fair play, and they were bound to protect themselves as far as possible against a competition which was unfairly carried on by the aid of the rates, to which they themselves were such large contributors. The chairman of the Brentford Gas Co. also had something to say on the subject of municipal electric

lighting. He said that they, like other gas companies, had been troubled by local authorities embarking on municipal trading in the way of supplying electric light. As large ratepayers, they had to contribute towards the cost of establishing competition against themselves, which hardly seemed fair. He was glad to say, however, that in connection with the Hanwell local authority's application for a provisional order to provide electricity for public and private use, the company had secured the insertion of what was known as the Duke of Northumberland's Committee clause, and this would afford them some protection.

Suart v. Electromobile Co., Ltd.—Mr. Justice Ridley, sitting without a jury in the King's Bench Division on Wednesday, heard an action by Mr. Alfred Suart, of the Bath Club, Piccadilly, against the Electromobile Co., Ltd., to recover damages for alleged breach of contract in regard to the sale of an electric landaulette to plaintiff, or alternatively for damages for breach of warranty. The defence was a denial that the warranty was given. The plaintiff had been the owner of Clarges Garage, and used to let out electric landaulettes. He purchased one for £250, which, he was told, was capable of running 30 miles on one charge, and which was warranted "in thorough working order, and complete in every particular." Plaintiff had it tested, and said now that it ran for 300 yds. and then stopped, and subsequent examination showed that it was defective in many respects. Expert evidence was called for the defence to the effect that the vehicle was in the best possible condition. Certain points as to insulation might have gone wrong, but they could easily have been adjusted. The motors were the best in the world, and all precautions were taken to insulate against dampness, &c. If there had been any mistakes in the actual connections, the car could not have run at all. Mr. W. C. West gave evidence that he had neither authority nor instructions from the defendants to give the warranty, whereupon his Lordship said that there would be judgement for the defendants without costs.

Salter and Others v. The Metropolitan District Railway Co.—On Wednesday, Mr. Upjohn, K.C., told Mr. Justice Farwell in the Chancery Division that he had a motion on behalf of the plaintiffs, for an injunction with regard to the electrification of the railway, but terms had been arranged, the costs provided for, and the matter would proceed under the Lands Clauses Act. His Lordship assented to this.

Attorney-General and Others v. The Urban Electric Supply Co.—In the Chancery Division of the High Court of Justice recently, Mr. Younger, K.C., asked to be allowed to mention this case. He said it was the Weybridge case with regard to laying down electric mains under the street. The defendants had come to a temporary arrangement with the Urban District Council to the effect that the defendants giving an undertaking that they would not break up the streets in pursuance of the second part of the notice of motion, the operation of the injunction with regard to supply should be stayed until after November 1st. Mr. Justice Joyce sanctioned the arrangement, and gave the parties leave to apply to him if any question arose.

Appointments Vacant.—Chief electrician to the Glasgow Corporation Telephone Department (£225); cable jointer for Hornsey (42s.); resident electrical engineer and manager for Marylebone (£600); an instructor in electric wiring for the West Ham Municipal Technical Institute; engineer-in-charge for Southport electricity works (45s.).

The Diesel Engine.—With reference to an article in our issue of March 25th last, our attention has been drawn to the fact that larger engines than those mentioned have been working for some time in this country—namely, of 160 and 240 B.H.P. Eleven standard sizes above 80 B.H.P. are made, the largest being of 680 B.H.P.

Australian Electrical News.—A Sydney correspondent, writing under date June 28th, says that the Sydney electricity department was having a trial run of the street lighting on that day, and hoped to light the streets by July 1st. The private consumers and public lighting connections together amounted to about 650 KW. out of an easy capacity of 1,200 KW., and a push one of 1,500 KW. It was expected that private consumers would get their supply by the end of July or early in August.

At Brisbane, Messrs. Edge & Edge have recently put in the first electric lift erected there. It is of the "New Standard" type.

The same correspondent, writing on July 4th, says that Messrs. Noyes Bros., who represent Westinghouse interests out there, have overcome the objections of the whole of the electrical firms in Melbourne to the appointment of Mr. Bradford as electrical expert to the Victorian Government for the scheme for the conversion of certain of their suburban railways. Mr. Bradford has also been appointed to the same position to the South Australian Government. This, says the writer, closes the hope of any other firm getting any part of the contracts at Melbourne or Adelaide.

An electrical association is being started in New Zealand, with Mr. Cameron as its secretary, *pro tem.*

Townsville (Queensland) has given Mr. Willard, of Sydney, instructions to prepare a scheme for electric lighting and power.

Fortitude Valley Electric Light and Power Co. has been authorised to supply current in North Brisbane. There is as yet no municipal supply in Brisbane, nor is there any talk of it just now. Messrs. Burton & Co., who at present supply electric light and power in the city, make the business pay well.

Melbourne City Municipality is reducing the price of energy for power from 3d. to 2d. this year. Last year it started with 246 motors, and ended with 395. It hopes to make a big jump, due to the reduction of cost of power, during the coming year.

The Australian General Electric Co. has equipped the Northern Extended Coal Mine (Newcastle) with Sullivan electric coal-cutters. A trial was satisfactorily run in June. The company has in hand the equipment of the Pacific and Rhondda Collieries on the same lines, including boilers, engines, generators, coal-cutters, &c.

Australasian Hardware and Machinery says that the electric tramway system is gradually being extended in Sydney. Already some of the steam tramways have been superseded, and now the cable tram between King and Ocean Streets is to be similarly displaced.

An electric tramway service is under consideration by the City Council of Invercargill (N.Z.).

The electric tramway installation at Wellington is so far advanced that trial trips over part of the route were made early in June.

Specific Heat of Superheated Steam.—Prof. Carpenter has recently published the results of tests on specific heat of superheated steam that have been carried out at Sibley College. He finds that pressure is a factor, and for moderate degrees of superheat he gives the equation $\kappa = 0.462 + 0.001525\,p$ when p is the absolute pressure in lbs. per sq. in. This holds good up to 120 lbs. for superheat of 30 to 70° F. It would also appear that the specific heat varies with the amount of the superheat, and with steam at 155 lbs. the following values are given by Mr. Emmet:—

Degrees of superheat.	Specific heat.
0	0·52
100	0·65
150	0·70
200	0·74
250	0·77

The rise is what one would expect from the researches of Berthelot, the specific heats of all gases rising with temperature.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—Mr. L. F. BICKELL, late assistant mains superintendent at Sheffield, has been appointed to a similar position under the Willesden District Council.

Mr. W. LUNN has been selected out of 75 applicants for the appointment of assistant engineer at the Lowestoft Electricity Works.

The St. Helens T.C. has increased the salary of the electrical engineer, Mr. HOLLINGSWORTH, from £350 to £400 per annum.

On August 7th Mr. W. J. U. SOWTER, chief electrical engineer at Bray Electricity Works, was married to Miss Annis Carter, of Coventry.

The salary of Mr. D. M. KINGHORN, electrical engineer to the Leigh Corporation, has been increased from £156 to £182 per annum.

At the Rochdale Electricity Works last week, on the occasion of the marriage of Mr. FREDERICK H. RUDD, station superintendent, to Miss Annie Crompton, of Bolton, Mr. Rudd was presented with a barometer from the employés of the station, mains and clerical staff. Mr. C. C. ATCHISON, chief engineer, made the presentation, and on behalf of himself and Mrs. Atchison, presented a case of silver serviette rings. In the earlier part of the day the station staff presented Mr. Rudd with a case of pipes, the presentation being made by Mr. ROBERT JONES, senior engineer-in-charge. Mr. Rudd was at one time with Messrs. Siemens Bros. & Co.

The Dewsbury E.L. Committee recommended that an honorarium of £25 be granted to the electrical engineer (Mr. R. H. CAMPION) for extra services. The chairman of the Committee explained that Mr. Campion had had a good deal of extra work in connection with the putting down of engines to meet the requirements of the Traction Co. He had undertaken the whole of this work. In previous years, when an extraordinary amount of work had to be done by their officials, the Council had recognised it in this way. The chairman also referred to Mr. Campion's recent action at the Leeds Assizes for slander. This case, he said, had really been brought about by a member of the Council. Without asking the assistance of the Council, Mr. Campion fought the question out in public, and won on every point. The man against whom the action was taken was practically without money, and Mr. Campion could not get compensation. It cost the engineer a considerable amount of money, and they all respected him for the action he took. Recognising this matter, and the special work he had done, the Committee thought they ought to recompense Mr. Campion. An amendment that the minute be referred back was carried.

Electric Tramway Officials.—Mr. J. FREDERIC JONES, who for the past three years has been manager of the Sydenham Electric Supply Co., has been appointed to the management of the Madras (India) Electric Tramway. He was to sail for Madras on August 6th.

General.—Mr. Arthur W. Towse, lately outdoor engineer and secretary to Messrs. Wells, Rayner & Co., has been appointed London manager to the A.B.P. Accumulator Co., of 39, Victoria Street, S.W.

Mr. W. B. Esson, who has acted as chief engineer to Messrs. Johnson & Phillips for over 10 years, retires at the end of the month, and will, as from that date, cease to manage the electric light and power works. During the period referred to, the firm has carried out many important works at home and abroad, for all of which, we believe, Mr. Esson has been primarily responsible.

Mr. S. H. Bell, late of Dudley, has succeeded Mr. Truscott as manager of the electrical department of Messrs. Beynon & Son, general engineers, Torquay.

Mr. A. Llewelyn Lean, A.M.I.E.E., who for the last five years has represented Mr. G. Braulik in the North of England, has, by mutual arrangement and for family reasons, terminated his engagement and removed to the South of England. Mr. Lean has been appointed the South of England representative of the A.E.G. English Manufacturing Co, Ltd.

NEW COMPANIES REGISTERED.

Electrical Fittings Co., Ltd. (81,756).—This company was registered on August 5th, with a capital of £15,000 in £1 shares (14,900 "A" and 100 "B"), to acquire the business of the Electrical Fittings Co., carried on by A. E. Parker, at 38, Conduit Street, W., to adopt an agreement with the said A. E. Parker, and W. R. Portsch, and to carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, motive power, or otherwise, manufacturers of and dealers in apparatus and things capable of being used in connection with the generation, distribution, supply, accumulation, and employment of electricity, &c. The first subscribers are:—A. E. Parker, 19, Air Street, Regent Street, W., gentleman, 1 "A" share; W. R. Portsch The Manor House, West Ealing, W., gentleman, 1 "B" share; P. Plater, Hamaia, Chorley Wood, Herts., gentleman, 1 "A" share; S. Ewan, 104, Henderson Road, Forest Gate, Essex, clerk, 1 "A" share; P. C. P. Richardson, 811, Goldhawk Road, Shepherd's Bush, W., electrical engineer, 1 "A" share; E. H. Walker, Glenhaven, Elstree, Herts., decorative artist, 1 "A" share; and R. Holmes, 6, Dowgate Hill, E.C., merchant, 1 "A" share. No initial public issue. The first directors are A. E. Parker, W. R. Portsch, P. Plater, and R. Holmes; W. R. Portsch and P. Plater are managing directors; A. E. Parker and W. R. Portsch may hold office for life; remuneration of W. R. Portsch as managing director, £106 for first year, afterwards £156 per annum; remuneration of P. Plater as managing director, £312 per annum; remuneration of other directors, two guineas each per board meeting attended (maximum in any year 20 guineas each), and 2½ per cent. of the distributed profits each. Registered office, 38, Conduit Street, W.

Imperial Engineering Supplies Co., Ltd. (81,710).—This company was registered on July 29th, with a capital of £1,500 in £1 shares, to carry on the business of suppliers of electrical and engineering fittings and accessories, electric light and power contractors, electrical and mechanical engineers, electricians, &c. The first subscribers are:—W. O. Manning, 31, Elliott Road, Chiswick, electrical engineer, 845 shares; F. E. Proctor, Dorincourt, St. Augustine's Avenue, South Croydon, electrical engineer, 100 shares; H. A. Hutton, 32, Park Road, Southport, engineer, 1 share; J. A. O'Loughlin, 345, Mount Broughton, Higher Broughton, Manchester, engineer, 1 share; J. J. Peach, 49, Devonshire Street, Ardwick, Manchester, engineer, 1 share; W. E. Syddall, 146, Bradshawgate, Bolton, clerk, 1 share; and W. H. Statham, Lymm, Cheshire, solicitor, 1 share. No initial public issue. The numbers of directors is not to be less than two nor more than seven; the first three are to be appointed by the subscribers; qualification, £100; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New Century Arc Light Co., Ltd. (67,849).—This company's annual return was filed on June 14th, when 14,306 ordinary and 5,000 preference shares had been taken up out of a nominal capital of £30,000 in £1 shares (25,000 ordinary and 5,000 preference). £1 per share has been called up on 2,506 ordinary shares, resulting in the receipt of £2,506. £16,800 is considered as paid on 11,800 ordinary and 5,000 preference. Mortgages and charges: £7,500.

Yorkshire Electric Tramways Construction Syndicate, Ltd. (77,167).—A debenture, dated July 22nd, 1904, to secure £70,000, has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital (if any), as a first floating security. Holder: H. S. Leon, Bletchley Park, Bucks.

Metropolitan Electric Supply Co., Ltd. (25,395).—A memorandum of satisfaction in full of charges dated July 30th, 1901; September 5th, 1902; and December 17th, 1902, securing in all £235,000, has been filed.

Electric Supply Corporation, Ltd. (52,036).—A trust deed, dated July 18th, 1904, to secure £50,000 debenture stock, has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: C. F. Tufnell, Kenley; and J. G. B. Stone, Draper's Gardens, E.C.

ELECTRIC TRAMWAY ACCOUNTS.

Glasgow, Hull, Birkenhead, and Wallasey Tramways.

The returns of these tramway undertakings for the past year are indisputable evidence of the popularity of electric traction with the general public; the quality of the results obtained may well be gauged by the Glasgow figures, where, despite the increase in gross revenue of nearly £70,000, augmented services by some 16 per cent. have somewhat pulled down the revenue per car-mile. The slightly increased average working expenses at Glasgow are attributed to increased taxes and accident insurance, although it would not have been surprising had this increase occurred in running expenses.

In the case of Hull, about 10 per cent. additional car-miles have been worked, and $\frac{1}{10}$d. per car-mile additional earned, but this is accompanied by nearly 1d. additional on to the average working expenses. (The increases are specially noticeable in traffic, repairs and maintenance, and taxes; power expenses showing a decrease.)

Birkenhead, which has worked 5 per cent. greater car-mileage, made a fractional increase in income per car-mile, accompanied by nearly ½d. per car-mile additional in working expenses, the latter being again attributed to increased items of repairs and maintenance and rates and taxes.

Wallasey, the near neighbour of the last-mentioned town, which depends largely on holiday traffic, records an augmented service by some 15 per cent., and a slight decrease in average revenue, accompanied by an increase of over ½d. per car-mile in working expenses. Here, again, repairs and maintenance is the most prominent among the increased items of expense.

The life of tramway track and equipment is always a matter for speculation, as also is the sufficiency or otherwise of the amounts provided for renewals and depreciation.

In this connection the figures for repairs and maintenance for the undertakings referred to for the past year are as follows:—

—	Car-miles per mile of track.	Repairs per car-mile.			Year of working.
		Track.	Electrical equipment of line.	Cars and equipment.	
Glasgow ...	116,365	1·30d.	·10d.	·44d.	5th.
Hull	100,513	·15d.	·24d.	†1·40d.	4th.
Birkenhead ..	57,434	* 44d.	·13d.	·25d.	3rd.
Wallasey ...	63,140	·09d.	·27d.	·62d.	2nd.

* As compared with ·27 last year. † As compared with ·81 last year. (It should be noted that these figures may show considerable variation from the previous year—according to the special circumstances accompanying the year's working.)

A point to which interest always attaches, in connection with municipal undertakings, is the disposal of the year's surplus. Glasgow has always occupied a strong position financially, and should serve as an excellent example to other undertakings; and it is worth noting that, despite its big surplus, nearly 9 times as much was voted to depreciation and reserve as for the relief of rates. Hull, on the other hand, gave twice as much to the rates as it placed to reserve. Birkenhead devoted its comparatively small balance entirely to renewals, and Wallasey satisfied its conscience by giving the rates £2,650, and depreciation and renewals £4,500.

GLASGOW CORPORATION TRAMWAYS.

For 12 months ending May 31st.	1904.	1903.
Length of route...	72	68
Total length of track	140	129
Average number of cars in use... ...	462·12	399·6
Car-miles run	16,291,082	14,008,750
Passengers carried per annum... ...	188,962,610	177,179,549
Capital expended to date	£2,699,776	£2,754,855
Traffic receipts	£717,893	£653,200
Total receipts	£724,851	£656,572
Working expenses	£356,820	£304,315
Gross profit	£368,031	£352,257
Income per car-mile	10·68d.	11·25d.
Working expenses per car-mile ...	5·26d.	5·21d.
Interest and sinking fund per car-mile	1·62d.	1·87d.
Total expenses per car mile	6·88d.	7·08d.
Profit or loss per car-mile	+3·80d.	+4·17d.
Cost of energy per car-mile	·30d.	·35d.
Average fare per passenger	·91d.	·88d.
" " charged per mile ...	·45d.	·45d.
Revenue per mile of route	£10,067	£9,655
Expenditure per mile of route ...	£4,956	£4,475
Total units used (energy generated in tramways power station)	15,372,609	13,168,975
Units used per car-mile	·94	·94
Percentage of working ex'es to receipts	49·25	46·4

PROFIT STATEMENT FOR 1904.

To interest on loans	£59,308
To sinking fund	45,553
To Govan and Ibrox Tramways, interest and sinking fund	5,038
To surplus on year's working	258,102
	£368,031

The surplus on the year's operations was allocated as follows:—Permanent way renewal, reckoned at £450 per mile single track, £60,827, or ·90d. per car-mile; general depreciation, £78,619, or 1·15d. per car-mile; special depreciation, £62,000, or ·92d.; or renewals and depreciation contributions of nearly 3d. per car-mile for the year. Other items were Parliamentary expenses, £12,865; payment in relief of rates, £25,000; and a balance of £18,790 placed to the general reserve fund.

HULL CORPORATION TRAMWAYS.

For 12 months ending March 31st.	1904.	1903.
Length of route	13½	10½
Total length of track	25	22
Cars in use	64·4	64
Car-miles per annum	2,512,821	2,293,282
Passengers carried per annum	24,220,718	22,062,703
Capital expended to date	£383,383	£341,042
Traffic receipts	£100,920	£91,492
Total receipts	£101,840	£92,343
Working expenses	£63,775	£48 939
Gross profit	£38,065	£43,404
Income per car-mile	9 75d.	9 65d.
Working expenses per car-mile	6·10d.	5·13d.
Interest and sinking fund per car-mile	1 83d.	1·91d.
Total expenses per car-mile	7·93d.	7 04d.
Profit or loss per car-mile	+1·92d.	+2 77d.
Cost of energy per car-mile	·83d.	·86d.
Average fare per passenger	1 00d.	1 00d.
Revenue per mile of route	£7,543	£8,395
Expenditure per mile of route	£4,724	£4,449
Total units used (energy obtained from tramways power station)	3,158 376	2,057,215
Units used per car-mile	1·26	·90
Percentage of working ex'es to receipts	62 5 %	53 %

PROFIT STATEMENT, 1904.

Interest on loans	£9,932
Sinking fund	9,148
Surplus for 1904	18,985
Gross profit	£38,065

To the above surplus was added the 1903 balance, amounting to £14,500, and allocations were made of £14,500 in aid of the rates, £7,485 to the reserve fund (which now totals £44,058), and a balance of £11,500 was carried forward.

BIRKENHEAD CORPORATION TRAMWAYS.

For 12 months ending March 31st	1904.	1903.
Length of route	13 52	13·52
Total length of track	23 53	23·53
Car-miles run	1,349,701	1,279 087
Passengers carried per annum	11,327,932	10,390,985
Capital expended to date	£345,960	£340,872
Traffic receipts	£54,672	£51,078
Total ,,	£56,073	£52,876
Working expenses	£34,747	£30,367
Gross profit	£21,326	£22.509
Income per car-mile	9·98d.	9 92d.
Working expenses per car-mile	6·18d.	5·69d.
Interest & sinking fund per car-mile	3·45d.	3 54d.
Total expenses per car-mile	9·63d.	9 23 d.
Profit or loss per car-mile	+ ·34d.	+ 69 d.
Cost of energy per car-mile	·736d.	·763d.
Average fare per passenger	1·16d.	1·18d.
Average fare charged per mile	·75d.	·79d.
Revenue per mile of route	£4,147	£3,910
Expenditure per mile of route		
Total units used (energy generated in tramway power stations)	2,128,607	1,953,095
Units used per car-mile	1 57	1·52
P'rc'ntage of working ex'es to receipts	61 96	57·43

PROFIT STATEMENT, 1904.

Interest on loans	£10,665
Sinking fund	8,777
Surplus on year's working	1,884
Gross profit	£21,326

The surplus on the year's working was transferred to the renewals account, which now stands at £8,996.

WALLASEY U.D.C. TRAMWAYS.

For 12 months ending March 31st.	1904.	1903.
Length of route	8½	8½
Total length of track	12	11
Total number of cars in use	30	25
Car-miles run	757,688	654,742
Passengers carried per annum	6,564,493	5,685,182
Capital expended to date	£127,912	£116,045
Traffic receipts	£35,265	£30,907
Total ,,	£35,873	£31,475
Working expenses	£23,980	£19,195
Gross profit	£11,893	£12,280
Income per car-mile	11 36d.	11·53d.
Working expenses per car-mile	7 66d.	7·03d.
Interest and sinking fund per car-mile	1 80d.	1·93d.
Total expenses per car-mile	9·46d.	8·96d.
Profit or loss per car-mile	+1·90d.	+2·57d.
Cost of energy per car-mile	2·66d.	2·43d.
Average fare per passenger	1·28d.	1·30d.
,, ,, charged per mile	·44d.	·44d.
Revenue per mile of route	£4 220	£3,703
Expenditure per mile of route	£2,821	£2.258
Total units used (energy purchased from electric lighting department)	1,243,340	979,133
Units used per car-mile	1·64	1·49
Percentage of working ex'es to receipts	67·3	60·99

PROFIT STATEMENT FOR 1904.

Interest on loans	£3,964
Sinking fund	1,618
Surplus on working, 1904	9,117
Balance on working, 1903, brought forward	−2,806
	£11,893

The surplus for 1904 was applied as follows:—Depreciation, £4,500; insurance, £1,000; in aid of rates, £2,650; promotion expenses, £100; balance carried forward, £867.

CITY NOTES.

Crompton & Co.

MR. JOHN TROTTER presided at the annual meeting held at Salisbury House on Monday last. He moved the adoption of the following report:—

"The net profits for the year ended March 31st amount to £14,584 5s. 4d., and, after providing for debenture interest and other items set out in the net revenue account, there remains, with the sum brought forward from last year, a balance of £8,054 10s. 11d. No interim dividend was paid in January last for the half-year ending September, but the directors now propose to place £750 to the credit of doubtful debts account, and to pay a dividend at the rate of 2½ per cent. for the year, carrying forward a balance of £1,221 14s. 8d. as compared with £1,098 10s. 9d. last year. Although the results of the working of the business for last year do not compare favourably with recent years in consequence of the general depression in trade and continued competition, the directors are pleased to state that there are now some signs of an improvement. The directors having registered a company, under the title of 'The Electric Supply Corporation, Ltd.,' have been engaged in obtaining business for that company. They have secured concessions or agreements in 17 towns in the United Kingdom for electric lighting and for tramways, and arrangements have recently been made for the necessary capital for carrying on the work. An agreement has been made with the new company that Crompton & Co. shall carry out all the contract work required for a period of five years at a satisfactory profit. An agreement has also been made with the Electric Supply Corporation to sell the whole of Crompton & Co.'s interest in the Chelmsford Electric Lighting Co., Ltd., this company taking shares and debentures in the new company in payment. The directors have every reason to believe that the new company will be a successful one, and that the securities thus exchanged will prove a profitable investment."

The CHAIRMAN referred to the disappointing results of the year. They had had a year of particularly hard work, and found at the end that the results were so disappointing and discouraging. They found at the end of the first half-year that the results were practically in proportion to what they were now, and they therefore did not feel justified in recommending any distribution of dividend. The accounts for the complete year showed that that was a proper course to adopt. At the end of the year they found that there was merely an amount of 2½ per cent. for dividend. In the last report they indicated that they had some hopes that they had passed through the bad times, and better times were in store. They did not then say that merely as a pious expression of hope, for they had reasons for believing that they were likely to do better, and those reasons were founded upon the fact that they had taken steps to obtain the very best technical advice from abroad and from this country, and had been for a long time overhauling all their designs with a view to cheapening and improving the output of their machines. At the commencement of last year they had got a very large way

through with that work, and knew that they could then afford to sell goods with a small, but reasonable, profit at a reduced figure, but every step they had taken to cheapen processes had been nullified by a steady drop in the market value of the regular goods made by electrical manufacturers during the year, and he regretted to say that this was still continuing. During the last few months he had had brought under his notice competitors' price lists, not of fancy articles, but of standard things—in which from month to month there was a drop varying from 10 per cent. to 25 per cent. Where that was steadily going on all round, he could see no end to it but the clearing out of weak houses, and then there might be some room for the stronger ones that remained. It was a very unsatisfactory state of things to contend with. They had not gone to sleep nor given way to despair; they had sought to put their own particular house into such a condition that they would not suffer possibly quite so much as some other people would. With that object in view they had been preparing an infant company which had recently been successfully launched, *i.e.*, the Electric Supply Corporation. It was registered as a syndicate some time ago, and was now a full-blown company with a list of 17 towns which it was prepared to electrify, and which Cromptons had been hard at work upon for a long time. That company was now thoroughly well established, and mutually satisfactory arrangements had been made between it and Crompton and Co. for it to get its goods direct from this company at first hand, at a reasonable price. They had also taken other steps which he believed would have an excellent effect upon the immediate future of the company. They had established a special department to watch over the sales of the company. They had hitherto done their selling and controlling of agents partly in London, and partly down at Chelmsford, and they felt that it was desirable that the works manager at Chelmsford should have the whole of his time to devote to the technical improvements of the works and the supervision of the regular manufacturing, and not have to give part of his time to supervising the selling of his production. They therefore established in London, under Mr. Packenham, a department solely devoted to sales. It enabled the selling department to come more directly into contact with the buyers in London, and also enabled him to follow every market move more perfectly than when it had to be done by someone with other duties to perform. That department had, to their mind, thoroughly justified its being, and shown good results, and, in the future, he believed it would show still better results. They might have adopted a course, which had not commended itself to them, by producing somewhat inferior articles at very low prices. They had carefully thought the matter out, and always maintained that their policy should be to turn out the best things possible, and they intended to continue that policy. They intended to keep in the forefront of the electrical world by producing thoroughly honest goods, with which no fault could be found, and which had nothing concealed about them, and also to keep in the forefront by intelligently anticipating all the requirements of the electrical world. They had an exceedingly high class of engineers, who had worked very hard indeed to try and mitigate the evil effects of trade. He believed that in this way they would survive when others did not survive. Recently he was told by their chief engineer that in one competition there were 60 tenders put in for one order. A few years ago, for the same work, they would have had three or six. With this enormous competition, when one got the public orders they were not really worth having, because of the low prices quoted to secure them. They were rather going in for such work as they could do with their own companies, where they could be in direct touch with the consumer, than seeking too much for that competition in public contracts where at present they did not see their way to get anything like a decent profit. After referring briefly to the reasons for handing over the business of the Chelmsford Electric Lighting Co. to the newly formed Electric Supply Corporation, he said that they would have desired to keep it, but those electric lighting companies were growing things which wanted a good deal of feeding. Year by year the amount invested in them must become greater, and they felt that they were not the type of investment that Cromptons, as a manufacturing company, ought to hold permanently; although they were sorry to part with the company just when it was doing well, they thought it would also enable the Electric Supply Corporation to start with a good business thoroughly well at work. The chairman then proceeded to refer to various items in the balance-sheet. The gross profit was £61,050 against £66,798 last year. For the first time in the history of the last few years the amount of their sales had dropped in value, but although it was less than in 1903, it was greater than in 1902; but the amount of work done, machines turned out, and weight of goods sold, and so on, was greater than at any previous time. It was really due to the drop in prices. If the general business improved, he saw no reason why the figures should not assume a more satisfactory aspect. The trading expenses were down from £27,000 to £25,217. The administration expenses increased from £13,565 to £14,894. £650 was the cost of establishing the sales department, and £160 had been spent in the establishment of a new Colonial agency to endeavour to get rid of their goods. Depreciation was £4,685, against £4,545. There was a loss on the Australian branch of £600. Affairs in Australia had been running very much the same course as in this country, and last year they did a very considerable amount of business, but at a small profit indeed, and the expenses left a loss of £600. This year they had got a contract there which looked like leaving a fair profit. In the balance-sheet there was an item of £10,000 loan from bankers. That was purely a temporary loan which had since been entirely paid off, and they did not owe the bankers anything now. When the balance-sheet was in course of preparation at March 31st, it happened to be at the time when they were arranging for the Electric Supply Corporation, and they had a large amount to arrange for just prior to settling up before the company was floated. That was now entirely cleared off. The stock-in-trade amounted to £151,000, as against £147,800. It was a very large sum, and one that they were watching very carefully.

Lieut.-Colonel Crompton seconded the adoption of the report, and it was unanimously agreed to.

The dividend resolution (2½ per cent.), and resolutions re-electing Mr. Trotter a director and the auditors, were also passed.

Metropolitan District Railway.

Mr. R. W. Perks, M.P., presiding at the meeting of this railway on 5th inst., said that he thought he might say that before they again met as shareholders they would be running electrically on the greater portion of their line. The line would not suddenly be converted to electric traction, but this would be a gradual process. As had been done in America, they would run electric trains alongside of steam trains during the period of conversion, but they expected that by January 1st they would be running a considerable portion of the railway by electric motive power, and that from early in the year the old District Railway would be transformed and wearing a completely new garb. They expected the result of this conversion would be to enormously increase their traffic. He had been looking into the figures of the Great New York railway—the Manhattan Railway—to see what the effect of conversion from steam to electricity was there. In that case the line was 36 miles in length, but was not an underground railway; it was an overhead railway working under conditions far more attractive than those of the District Railway, but the result of conversion had been perfectly amazing. In 1900 the company earned £1,800,000 gross, its working expenses being 60 per cent. In 1903 its earnings rose, under electrical traction, to £2,400,000, and the working expenses had fallen to 45 per cent. In other words, the company was carrying 320,000,000 people per annum, against 200,000,000, and practically carrying them at the same cost. If those results, or anything approaching them, could be accomplished on the District Railway, the prospects of the shareholders were brighter than they had been in the whole of the company's history. They were sometimes told that no signs of active work or progress were visible upon their railway; but, as a matter of fact, 1,000 people were employed nightly upon it, and the work was done under circumstances of great difficulty. Great progress had already been made. Mr. Chapman told him that the great Chelsea generating station, which would cost ultimately £1,400,000, was completed, that 16 boilers of 520-H.P. had been under steam, and that the remaining 48 boilers were rapidly approaching completion. Everything, in fact, at that station was complete and ready for working, except the turbo-generators, which were already overdue, and were being made at the Westinghouse Works, Old Trafford. Delivery of the first of these generators was promised, and it was to be under test in September, and others were to follow rapidly. 72 miles of cables had been laid underneath the streets in the duct chambers from Lots Road to Earl's Court, whence those cables were distributed all over the railway, west, south and east. They had finished many of their sub-stations—Whitechapel, Earl's Court, Ravenscourt Park, Mill Hill Park, Hounslow, Sudbury and Putney. In all those buildings the electrical machinery had already been fixed, and several of those stations were ready for work. At Mansion House their sub-station was ready for roofing in; the machinery would be placed there in September. At Charing Cross they had had very heavy work in the excavation of a large area beneath the streets and the Embankment Gardens for the construction of that sub-station. This would be finished in about six weeks, and the machinery placed there in October. At Victoria and South Kensington the sub-stations were well advanced, and the machinery there would be placed in September. West of Mansion House, on their main lines, they had already laid 7,500 tons of conductor rails. They had completed the laying of those rails on 18 miles. They had laid 86 miles of cable ducts in their permanent way, and 23 miles beneath their station platforms. They had laid 68 miles of high tension three-phase cable. Their signal system was practically complete, except upon the eastern joint lines. At Mill Hill Park their great car-sheds, which were costing nearly £70,000 to build, and covered an area of 4 acres of ground, were nearing completion, and would be roofed in and finished, they hoped, by October 1st. As to rolling stock, the Underground Co. had placed contracts for 420 cars, delivery of which would commence in October, and a large portion of the stock would be ready for service at the close of the year. He would here answer a question which had been put to him, whether it was true that a considerable portion of the order for their cars had been placed abroad. In answer to this, he had to say that for 280 of their 420 cars—that was to say, 40 trains—orders had been placed on the Continent, the reason being that the tenders of the English car-builders were at least 30 per cent. to 40 per cent. above the prices quoted by Continental car-builders on exactly the same specification and for identically the same article. The Underground Co. used their utmost endeavours to persuade English car-builders to reduce their price, but were unable, and therefore they placed the order for 40 trains with the Continental builders; but no sooner was this order placed, than the English car-builders reduced their figure to the same standard as their Continental competitors, and the remaining 20 trains of 140 cars were taken at the same price, practically, as the foreign car-builders had quoted, although that price was 30 per cent. less than the price previously quoted by the English car-builders. He did not know whether the proprietors would have wished the Underground

Co. to spend £120,000 more money purely for what was called patriotism, but at all events they did not conceive that to be their duty. Had the English car-builders quoted, in the first instance, the same price as was quoted by their foreign competitors, the whole of the work would have been placed in this country, and the Underground Co. would have been delighted even to give a small sum in excess of the prices actually paid, so as to have kept the order here. He did not know which branch of the railway they would first work electrically. They might first run their trains from Ealing direct to Mansion House, or they might first deal with the Inner Circle. He noticed the Metropolitan Co. said that if the District were ready by the first of the year they themselves hoped to be ready. He could only reciprocate that statement, and say that if the Metropolitan were ready, the District were certain to be.

Great Northern and City Railway Co.

The report for the half-year ended June 30th last, states that the railway was opened for public traffic on February 14th last, and the receipts for the 19 weeks and 5 days, up to and including June 30th ult., amounted to £19,354. The number of passengers carried during the above period, excluding season ticket holders, was 2,711.152. The number of season tickets in use at June 30th, 1904, was 758. The working of the railway has been in every way satisfactory; but the traffic receipts are so far disappointing, owing almost entirely to the fact that the negotiations with the Great Northern Railway for interchange of through booking facilities have not as yet been completed, and the returns, therefore, show practically no traffic, either in ordinary or season tickets to or from Great Northern suburban stations. Receipts from local traffic are steadily increasing, and when the arrangements with the Great Northern Railway Co. are completed, which it is hoped will be very shortly, the revenue will certainly show a more satisfactory result. The station at Highbury was not opened to the public until June 28th last. As was anticipated, it has already been productive of a considerable increase of traffic, although the lifts are not yet working. The agreement for working the railway by the contractors for three years from its opening provides that S. Pearson and Son, Ltd., shall retain in respect of such working 65 per cent. of the gross receipts from all sources, and that the remaining 35 per cent. shall belong and be paid over to the company. The contractors have guaranteed while they so work the railway a minimum interest of 4 per cent. per annum on the "A" shares, if the net receipts paid over to the company be insufficient; and also a minimum interest of 3 per cent. per annum on certain "B" shares.

Tyneside Tramways and Tramroads Co.

The half-yearly meeting of this company was held on the 8th inst., at Newcastle-on-Tyne, Lord Armstrong presiding. The report showed a surplus of receipts over expenses of £1,454 18s. 6d., and recommended a payment of a dividend of 2 per cent. per annum.

Lord Armstrong, in moving the adoption of the report, pointed out that the company's new line to Gosforth was opened before race week with satisfactory results. Referring to the company's application to Parliament for running powers, his Lordship said the application, and the proceedings in connection therewith, had involved their directors in much anxiety, it being necessary to sacrifice, to some extent, the steady increase of their net profits during the past six months for the sake of the ultimate welfare of the company. They were pledged to the Wallsend Corporation to obtain running powers over the lines of the Newcastle-on-Tyne Corporation so as to avoid the vexatious change of cars and delays at the junctions between their system and that of the Newcastle Corporation. They felt that some arrangement for through running was necessary, not only to carry out their pledge to Wallsend, but also in the public interest, and as the receipts of any tramways undertaking depended on the extent to which it filled the public want, it followed that if the arrangement for through running were equitable as between their system, and that of Newcastle, then both tramways would, of necessity, make additional profits. It was evident to them that some equitable arrangement was possible, but as the friendly negotiations which on two occasions they initiated with Newcastle-on-Tyne fell through, they had no alternative but to appeal to Parliament. A great deal of misconception at one time prevailed as to their object in doing this, the idea in some people's minds apparently being that their application was an attempt to withdraw from the Corporation a portion of their legitimate profit; this was, of course, never their intention, and they were able to convince both the Committees of the Lords and Commons of that, and of the public advantages which would accrue from through communication. As a consequence their Bill passed the Committee stage of both Houses. It was then opposed in the House of Commons itself on the third reading, or rather at the report stage, by a party organised through the Association of Municipal Corporations, who urged that, however desirable through communications might be, it should be in no case the result of compulsion, but instead, should always be arrived at by agreement. He did not propose to discuss the merits of this argument as applied to their case, where the company had always been desirous of securing an agreement; it was sufficient to say that the House of Commons decided to refer their Bill back to the same Committee in order to see if an agreement could not be arranged. The effect of this reference was to bring the influence of the Committee to bear on the question, and he was glad to says that, as a result, an agreement had been arranged. The agreement was, they considered, a reasonable one. That was, it would result in considerable benefits to both parties. Passing on to other matters, he said, so far as could be seen, the electrification of the North-Eastern Railway had had no adverse effect on the company's receipts. He also pointed out that for the past six months the average returns receipts had increased by £62 per week, as compared with the corresponding period of last year.

Dr. Merz seconded the adoption of the report, which was carried.

A formal motion regarding the dividend was passed.

Liverpool Overhead Railway Co.

The half-yearly meeting was held on the 9th inst., at Liverpool, Sir William Forwood presiding.

The Chairman, in moving the adoption of the report, regretted it was not more favourable. Their railway, in common with all railways in the country, had suffered very much during the past half-year through the slackness of trade, and probably they felt it more than other companies, because they depended entirely upon movement of passengers in connection with the trade of the port. When trade in Liverpool was brisk, gangs of men made use of their railway three or four times during the day, but when trade was slack, as at present, there was not the same movement of working men on the railway. They had also suffered from a considerable diminution in the holiday traffic. The receipts for the half-year had been £41,780, as compared with £41,549 in the corresponding half of last year, while their expenses had decreased from £32,005 to £31,729. They had spent an increased sum on the maintenance and renewal of the permanent way, and he might mention that the renewal fund now stood at £27,559. They had relaid about two-thirds of the line, and hoped to complete the work by the end of the year. They had also concluded an agreement with the Lancashire and Yorkshire Railway Co., and had let the contract for making a physical connection with that line at Seaforth, and under the terms of that contract the work ought to be completed by next February, when they hoped to be running a through service to Southport in connection with the Lancashire and Yorkshire Railway. As promised at their last meeting, a special committee of the directors had been inquiring into the possibility of effecting economy in the management of the line, but although they had made some useful suggestions, they had not been able to recommend any serious economies, inasmuch as the line was very largely automatic in its working. He hoped when the cotton and shipping trades revived, they would have increased prosperity for the line. At the present moment they were entirely dependent upon the trade of the port.

The motion was seconded by Sir Edward Lawrence, and carried unanimously, some of the shareholders expressing a hope that they would soon receive an increased dividend.

Chloride Electrical Storage Co.

The directors' report for the year ending June 30th, 1904, says that the trading profit for the financial year was £17,510 9s. 1d. After deducting directors' and auditors' fees (to June, 1903), debenture interest, depreciation, provision for bad debts, and interim dividend on preference shares, the available balance for the year is £5,073 14s. 4d., to which must be added £7,312 9s. brought forward from last year, making a disposable balance of £12,386 3s. 4d. The directors propose the payment of a dividend of 6 per cent. on the preference shares for the financial year, less interim dividend already paid, and a dividend of 8 per cent. on the ordinary shares, free of income-tax, together amounting to £4,520, and to carry forward the balance, £7,866 3s. 4d.

Consolidated Electrical Co.

Mr. Herbert Allen presided over the annual meeting, held at River Plate House, E.C., on Monday. In moving the adoption of the report for the 11½ months ended at March last (see Elec. Review, August 5th), he said that the delay in issuing the report was due to stocktaking. The report was a plain, straightforward, and intelligible document, which aimed to place before them the position of the company as it really was. There was nothing to be enthusiastic over, but it might have been much worse. In regard to the balance-sheet, leaving on one side the capital liabilities, and on the other side the goodwill, they had a surplus of assets over liabilities amounting to £52,736, but, of course, the value of those figures depended largely upon the valuation put upon the investments, and the plant, machinery and stock-in-trade. The investments would ultimately prove to be worth much more than they figured at in the accounts. The valuation of the buildings, plant, and machinery was £9,225, and the stock-in-trade, &c., £11,084. The directors were responsible for the valuation of the buildings, and the staff was responsible for the valuation of the machinery, plant, and stock-in-trade. He knew of no unbiassed firm who could give a valuation worth a brass farthing in comparison with one properly prepared by their own staff. The balance-sheet was the first careful valuation that they had had for years. In regard to the loans, £3,313, this sum was paid off a very short time after the balance-sheet was made up. After referring briefly to the directors' fees, he said that the general charges for the current year would not be more than £2,000, unless they had heavy legal expenses. They would have some—the remaining legacy of past neglect—but there were no large sums involved. He had promised, at previous meetings, that the

administrative charges should be very largely reduced, but it had not been a pleasant task to cut down the staff by getting rid of men who had been with the company for 10 or 20 years. Mr. Allen then spent some time replying to criticisms which had been made in the *Financial Times*, and by Mr. W. R. Lawson, a shareholder. The application for a Stock Exchange quotation had not been proceeded with, because the time was not opportune. In regard to the balance from trading account, nothing would have been easier, had they desired, than to show a good result on trading by putting problematical values upon the stock-in-trade, but that course they would not countenance. They hoped, now that the thorough valuation had been made, to be able to give trading figures in future. In their experience respecting slackness of orders they were by no means alone. In 1903 they held their own fairly well—quite sufficiently to justify all the statements made at the last meeting. He was even being urged to sanction an outlay of £8,000 upon works extensions, but he was determined to proceed cautiously, and was thankful that the outlay was not sanctioned. Economies had been effected in every possible direction, and the factory results were now being very carefully watched. It would depend very much upon the outcome of the next month or two whether they would continue the manufacturing business. If they could get good and profitable orders, they would keep them going—they were in a very efficient condition—but they were not going to bolster up the manufacturing business, if it could not pay, at the expense of their valuable investments. In no respect could it be said that the loss was unexpected, for last year he told them they could not expect a dividend for the present year. He was not yet able to speak with confidence of an immediate dividend, as so much depended upon the trade outlook. Apart from the trading section, the income from other sources was absolutely assured. He was not satisfied that there were any profits made in the past years of the company, and it was to the influence of past years that he attributed the rapid absorption of so much of their new capital. The thing which bothered them most of all was the present uncertainty in regard to the factory results, and the difficulty in which it placed them with reference to the payment of the dividend on the preference shares. That dividend was payable out of the net profits of the company, and they were advised that they must not pay it until the profit had been ascertained. Without a reliable trading account, they dared not say that they had made a profit, or the reverse. They were now considering whether there was any step open to them so that they could pay the preference dividend this month, but that was all he could say. If manufacturing were stopped the preference capital would be paid off by the sale of the plant, machinery and premises, and the remaining assets would remain solely for the benefit of the ordinary shareholders. The policy of the board would be to nurse the assets a little while and then distribute them among the shareholders. But they would certainly not do that until they had satisfied themselves that they had to give up manufacturing. He then formally moved the adoption of the report, with a slight alteration in paragraph 6 (£650 being substituted for £800 [see our last issue]).

After some discussion the resolution was adopted, the retiring director (Mr. H. Allen, the chairman) was re-elected, also the auditors, and the meeting closed with a vote of thanks to the chairman.

Electro-Peat-Coal Co.—The statutory meeting of this company was announced for Tuesday afternoon last at Westminster Palace Hotel, and our representative presented himself for admission in the usual way, but he was informed that the meeting was a private one, and that "a report had been arranged for." Perhaps someone among our readers, if any were so unfortunate as to take shares after reading our criticism of the prospectus, may be able to tell us why there is this need for privacy about the proceedings of the Electro-Peat-Coal Co.

Coventry Electric Tramways Co.—An extraordinary meeting of this company was held at the offices, 20, Bishopsgate Street Within, E.C., on Wednesday. Our representative was informed that the meeting was private, but we understand that it was convened for the purpose of authorising the borrowing by the company on mortgage of the sum of £10,000 at 4½ per cent. per annum interest, a resolution to that effect being carried.

Prospectus.—Messrs. Graham, Morton & Co., Ltd., of Leeds, something of whose recent enterprise is known to readers of the Electrical Review, have this week been before the public with a new issue of 80,000 7 per cent. cumulative preference shares. The list was to close on Wednesday. The money is needed to discharge certain temporary advances, and to provide further working capital to meet the extending business.

Northampton Electric Light and Power Co.—The directors have resolved to pay an interim dividend at the rate of 4½ per cent. per annum on the ordinary shares for the half-year ended June 30th last.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—Madras Electric Tramways (1904), Ltd., £50,000 5 per cent. debenture stock.

Edwards Air Pump Syndicate, Ltd.—The directors have declared an interim dividend for the half-year ending June 30th at the rate of 10 per cent. per annum.

Change of Name.—We are asked to state that the title of the "Blackheath and Greenwich District Electric Light Co., Ltd." has been altered to the "South Metropolitan Electric Light and Power Co., Ltd."

STOCKS AND SHARES.

Wednesday Evening.

Unaffected by politics, money, Board of Trade returns, or the wild gambles in Consols, electrical issues mostly maintain a stolidly firm front, and the changes which have occurred are chiefly in the upward direction. Business, the dealers themselves admit, is far from being bad, and the firmer tone, of course, owes its source to investment demand. The Stock Exchange has begun another of the greatly disliked nineteen-day accounts. They are traditionally supposed to be bad for trade, prices and markets generally, but do not have much influence over the electricity sections, although the most optimistic broker will hardly dare to prophesy any real activity during the present month.

Railway stocks are decidedly dull. They have fallen under the mal-influence of the causes mentioned above, and no outside support has been forthcoming. City and South London dropped to 44¼ early in the week, but recovered part of the decline, although the net loss is still two points, at 45. One or two selling orders, in a market unwilling to take more stock, accounts for the weakness, and the beautiful weather is having a bad effect upon Tube traffics all round. Central Londons are steady, and Metropolitan Consolidated kept up fairly well, because the dividend is being deducted from the price this week. Districts are not better than 36. The Gt. Western started a new service of motor trains on one of its lines last Sunday, the service running between Uxbridge Rd. Station and Perivale. Much interest attaches to the first report of the Great Northern and City Railway, and the directors state that although the working of the railway has been in every way satisfactory, the traffic receipts are so far disappointing, "owing almost entirely to the fact that the negotiations with the Great Northern Railway for interchange of through booking facilities have not as yet been completed." The Preferred shares are 4¼ middle, which would have its equivalent in stock standing at 42½, or rather less than City and South London Ordinary. The North London Railway complains that competition from the new Great Northern and City has had something to do with a decrease in the North London Co.'s gross receipts amounting to £7,710 for the half-year.

Amongst Traction issues, British Electric Ordinary have pulled up ¼ to 9, and there is a little more business doing in them. Cape Electrics, *ex* rights, are 1⅞—2. There is still some interest taken in Metropolitan Electric Trams Deferred at 5s., and the 5 per cent. Accumulative Preference are a shilling or so under £1. Anglo-Argentine Ordinary seem to have settled down to about 6½, and the Preference at 5¼ are also steady. London United Preference have been done at 10⅝, City of Buenos Ayres at 9 15/16, and Belgrano Ordinary at 3 1/16. Investors are putting money into Perth (W.A.) Electric Tramways 5 per cent. Debenture stock, which can be bought at par, or a shade over. Calcutta Tramways Debenture is 106, and Auckland Debenture—a good 5 per cent. stock—has been dealt in round about 99. Madras Electric 5 per cent. Debenture is quoted at 102½. A fresh slump in British Westinghouse Preference shares took the price to 3; it seems hardly to be realised even yet that the dividend for the six months to the end of last month is not likely to be paid. The Debentures are 86½, and British Thomson-Houston Debenture 102.

In the Electricity Supply list, the only noticeable fall is one of 10s. in City of London Ordinary, which brings the price down to 10½. Several of the other shares have recovered their recent dividend deductions. Westminsters are 10s. up at 13, St. James's ½ at 15, and Edmundson's added the fraction at 6½. Chelseas advanced ¼ to 6⅝ on the increase of ¼ per cent. in the dividend, and Urban Preference gained a similar fraction at 5. Folkestones at 6 are somewhat better, and Calcutta Electric Supply rose to 7 1/16. Amongst prior-charge stocks, a point gain put Central Electric Debenture to 107½. It seems hardly necessary to observe that there is no market in the shares of the Electric Peat-Coal Co., whose statutory meeting was held on Tuesday last.

Three insignificant changes barely break the monotony of the Telegraph Section. Anglo-American Preferred is 1 easier at 90, and the market for the stocks cannot be called a good one. Eastern issues continue unaltered, and the Extreme-Eastern struggle fails to affect them in any degree. Western Telegraphs came on offer, and are ¼ down at 12¼, while Telegraph Constructions receded £1, to 36½. Telephone varieties are equally motionless. None of the National Co.'s stocks have changed, although Lord Stanley is still answering questions about the "negotiations." Chili Telephones are ¼ up, recovering the amount of the dividend deducted at the end of July.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Aug. 3rd.	Closing Quotations Aug. 10th.	Business done week ended Aug. 10th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½— 3½	2½— 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	6ls.	6d/6	6ls.	45 — 48 xd	45 — 48	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	90 — 92 xd	89 — 91	90½	89½
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	6½— 7	6½— 7	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	4¾— 5⅛xd	5 — 5½	5 7/32	5 1/16
13,333,300$	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	94 — 96	94 — 96	94½	9.½
16,000	Cuba Telegraph	10	4 %	6½%	5 %	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
12,981	Direct Spanish Telegraph	..	..	..	..	.. — ..	.. — ..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101%	98 —101 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3 %	10 — 10½xd	10 — 10½	10 7/32	..
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	99 —101	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129 xd	124 —129	127	124½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	86 — 89	86 — 89	87	..
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	107	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11¾— 12¼	11¾— 12¼	12 3/16	11⅞
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	103 —106 xd	103 —106	105	103
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	97 —100	97 —100	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	8⅞— 9¼	8⅞— 9¼	8 15/16	8⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	13½— 13¾	13½— 13¾	13 1/16	13⅜
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	25½— 26½	25½— 26½	..	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	42 — 45	42 — 45	43	..
1,988,388	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —105 xd	103 —105	104½	103
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	86 — 89 xd	86 — 89	87	86
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14 xd	12 — 14	14	13½
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13 xd	11 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼xd	5 — 5¼	5 1/16	5⅛
600,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	98⅜	97⅜
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	104½	..
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	64 — 66	64 — 66	66	65⅝
179,318	Oriental Telephone and Elec. Nos. 1 to 171,604, fully paid	1	6 %	6 %	6½%	1⅜— 1 7/8	1⅜— 1 7/8	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	99½	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	7⅛	..
3,808	Submarine Cables Trust	Cert.	..	..	..	118 —123	118 —123	..	..
56,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6½	6 — 6½	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5½	4½— 5½	5 1/32	4 29/32
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	12¼— 12¾	12 — 12¼	12⅛	12¼
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	99 —102	99 —102	..	..
88,321	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 6¾	6½— 6¾	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	92 — 97	92 — 97	..	..
100,000	British Electric Traction	10	9 %	8 %	..	8½— 9	8⅞— 9¼	9⅛	8⅞
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10⅞— 11⅛	10⅞— 11⅛	11 1/16	11
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	116 —119	116 —119	118⅛	117⅝
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅞— 6⅛	5⅞— 6⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	6⅛— 6 xd	6⅛— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	7/16— ½	7/16— ½	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	¾— 1	¾— 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	¾— 1⅛	¾— 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
'25,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	71 — 76	71 — 76	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½— 10⅛	9½— 10⅛	10⅛	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	101 —105	101 —105	102⅜	102½
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	89 — 91	89 — 91	90½	90
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	102 —104	102 —104	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	79 — 81	79 — 81	..	..
1,380,000	City and South London Railway	Stock	2 %	3½%	2¾%	46 — 48	44 — 46	47⅜	45
85,000	Crompton & Co., Nos. 1 to 85,000	5	7½%	5 %	..	1½— 2	1½— 2	1 15/16	1 7/8
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	94 — 97	94 — 97	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	Nil	..	½— ¾	½— ¾	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000£	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 83	79 — 83	..	..
a12,100	Electric Construction, 1 to 112,100	2	6 %	6 %	4 %	1 — 1½xd	1 — 1½	1 3/32	1 3/32
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2 — 2½xd	2 — 2½	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9½	9 — 9½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11 — 12	11 — 12	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	19⅜	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3¾— 4	3¾— 4	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	36 — 39	35 — 38	36	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	99 —102	99 —102	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3⅛%	3⅛%	89 — 92	89 — 92	..	..

A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME,	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Aug. 3rd.	Closing Quotations Aug. 10th.	Business done week ended Aug. 10th, 1904. Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡	..	..	..	⅜ — ⅞	⅜ — ⅞	..	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..
100,000	Do. 4½% 1st Deb. Stock	100	..	..	..	102 —106	102 —106	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	8 %	10 %	10⅜ — 11¼	10⅜ — 11¼	11⅛	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼ — 10⅜	10½ — 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	106 —109	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7½ — 8	7⅝ — 8	7⅞	7⅞
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5½ — 5⅞	5½ — 5⅝	5⅝	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4½ — 5	4½ — 5	..	..
40,000	Do. do. 1903	5	..	..	..	4½ — 5	4½ — 5	4⅝	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5½%	6½ — 6⅞	6½ — 7	6⅞	6⅞
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	107	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	5 %	5 %	5 %	10⅜ — 11½	10½ — 10⅝	10⅝	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	13⅞	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	120 —125	120 —125	121¼	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	7½ — 8½	7½ — 8½	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11 — 12	11 — 12	11⅛	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	105 —108	105 —108	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5⅞ — 6¼ xd	6 — 6¼	6⅛	..
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	5⅞ — 6	5⅞ — 6	5⅞	5 13/16
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	104 —107 xd	104 —107	106½	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12½	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	8	..	..	..	1¼ — 1⅜	1¼ — 1⅜	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	94 — 97	94 — 97	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6½%	7½%	8½%	15½ — 16½ xb	15½ — 16½	16⅛	16
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5½ — 5⅝	5½ — 5⅝	5½	5 5/16
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112	108 —112	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
10,853	Notting Hill Electric Lighting	10	6 %	6 %	6 %	12½ — 14½	14 — 15	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15 xd	14 — 15	14⅜	..
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	5	..	..	..	8 — 9 xd	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	2⅜ — 3½	2⅜ — 3½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	88 — 88 xd	88 — 88	..	..
65,000	South London Electricity Supply, Ord.	5	..	1¾%	8 %	3⅜ — 4½	3⅜ — 4½	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	4½ — 5	4½ — 5	4⅞	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4½ — 5	4⅝ — 5⅛	4⅝	4 15/16
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12 — 13 xd	12½ — 13½	12⅝	12½
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6½	6⅛	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, August 10th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	33/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£38 10	..
a ,, ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£20	30/- dec.
a Lead, Nitrate	per ton	£30	£6 inc.
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	8d.	..
a ,, Caustic (75/80%).. ..	per ton	£24	..
a Shellac	per cwt.	210/-	10/- inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks.. ..	per lb.	2½d.	¼d. dec.

METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£190	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£48 to £130	..
c Brass (rolled metal 9" to 12") basis	per lb.	6¾d.	..
c ,, Tube (brazed)	per lb.	8¼d.	..
c ,, ,, (solid drawn).. ..	per lb.	7¼d.	..
c ,, Wire, basis..	per lb.	6¾d.	..
Copper Tubes (brazed) ..	per lb.	9¼d.	..
,, ,, (solid drawn) ..	per lb.	9¼d.	..
Copper Bars (best selected ..	per ton	£70	..

METALS, &c. (continued).		Latest Price.	Week's Dec. or Inc.
g Copper Sheet	per ton	£70	..
g ,, Rod	per ton	£70	..
c ,, (Electrolytic) Bars ..	per ton	£62	..
c ,, ,, Sheets ..	per ton	£78	..
c ,, ,, Rod ..	per ton	£72	..
c ,, ,, H.C. Wire	per lb.	7¾d.	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
m German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/11½ to 5/0½	inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	43/4	5½d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£12 2 6	2/6 inc.
g ,, ,, Sheet	per ton	£11 17s. 6d.	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 17 6	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/3½	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	£4	..
c Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£123 10	dec.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/6½	..
p White Anti-friction Metals—			..
"White Ant" brand ..	per ton	£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 8 ply 10 lbs. Russian ..	per lb.	4 13/16d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne brd.)	per ton	£25 5	..

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co., f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Aberdeen	Aug. 6	1,664	+286	10	14,756	+ 3,110	10	—
Bath	,, 3	1,150	—	32	19,069	—	12½	—
Birmingham ..	,, 6	6,922	+650	32	173,003	+11,320	32	—
Blackburn	July 29	999	+144	18	17,533	+ 1,555	13½	—
Blackpool	Aug. 4	2,571	+793	18	20,750	+ 2,308	8½	—
,, —Fleetw'd	,, 6	2,351	+109	5	7,214	— 41	7½	—
,, —Lytham	,, 4	1,127	+176	40	12,682	+ 6,201	7½	—
Bolton	,, 7	1,981	+ 43	19	35,833	+ 201	25	—
Bournemouth ..	,, 3	1,713	+ 49	18	20,571	—	10½	—
Bradford	July 30	4,880	+789	17	80,866	+13,997	50	—
Brighton	Aug. 7	2,211	+439	—	19,770	—	9	—
Bristol	,, 5	7,008	+395	—	—	—	28	—
Devonport ..	July 29	565	+ 43	30	15,695	+ 2,479	5	—
Dudley—Sto'rb'ge	,, 29	990	+ 81	30	26,249	+ 993	18½	—
Gateshead ..	,, 29	918	+ 8	30	26,961	+ 1,262	10½	+ ½
Gr'n'k—Pt. Glsgw	,, 29	680	+ 23	30	16,802	+ 796	7½	—
Oldham—Ashton	,, 29	579	+ 1	30	16,312	— 772	8	—
Potteries	,, 29	1,748	+ 96	30	51,067	+ 4,458	28½	—
South Staffs. ..	,, 29	725	—248	30	23,065	— 2,563	21½	—½
Swansea	,, 29	599	+ 14	30	16,011	+ 973	5½	—
Wolverhampton..	,, 29	898	— 2	30	11,456	— 194	10½	+8
Yorks. Wool Dist.	,, 29	736	+ 202	30	17,823	+ 7,600	6	—
Miscellaneous ..	,, 29	4,734	—	30	109,280	—	—	—
Burnley	Aug. 6	1,044	+142	—	—	—	10½	+3½
Burton-on-Trent ..	,, 7	506	+ 14	18½	6,744	—	8½	—
Cardiff	July 30	2,255	+122	17	36,261	+ 935	14	—
Chatham & District	Aug. 4	862	+ 47	31	18,186	+ 2,229	8·58	—
Cork	,, 4	555	—416	31	14,283	— 1,731	9	—
Dover	,, 6	370	+ 29	32	6,601	— 255	3	—

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Dublin	Aug. 5	6,352	+ 506	—	29,118	— 3,967	47	+ ½
East Ham	,, 6	995	+ 5	18	14,391	+ 1,494	5	+ ½
Glasgow	,, 6	14,901	+1504	10	138,434	+ 4,926	71½	+6½
Halifax (2 weeks) ..	July 27	3,348	+277	17	26,350	+ 1,871	33	+1½
Huddersfield ..	Aug. 6	2,517	+1071	18	—	—	28	—
Hull	,, 6	2,583	+486	18	39,892	+ 5,159	13	+2½
Ilkeston	,, 3	207	— 47	18	2,731	—	3·5	—
Ipswich	,, 6	832	—	18	9,704	—	10½	—
Isle of Thanet ..	,, 6	2,360	+ 51	31	18,960	+ 138	10½	—
Leeds	,, 6	7,909	+1245	—	—	—	81½	+2
Liverpool	July 23	14,144	+ 3328	30	307,398	+10,827	108	—
London C. C. ..	,, 30	13,708	+4084	17	213,986	+41,256	46½	+6½
Manchester	Aug. 6	13,820	+671	18	226,311	+ 8,123	131½	—
Newcastle	,, 6	3,965	+214	—	—	—	17	—
Portsmouth	July 30	2,229	+247	—	35,858	+ 3,298	14½	—
Salford	Aug. 8	4,242	+176	—	77,331	+ 6,085	30	—
Sheffield	July 31	4,736	+ 58	18	85,958	+ 2,642	33	+5½
Southampton ..	,, 28	1,031	— 77	—	—	—	9	—
Southend-on-Sea ..	Aug. 3	805	+146	18	6,127	— 854	6½	—
Sunderland	,, 7	1,786	— 69	17	24,680	+ 646	21	+1
Tyneside	,, 3	628	+ 46	31	11,871	+ 2,096	8·9	+ ·4
West Ham	,, 4	1,472	—	23	19,178	—	8·62	—
Wolverhampton ..	,, 3	1,004	+544	—	—	—	9·508	—
Cen. London Rly. ..	,, 6	5,696	—449	5	80,294	— 1,870	6	—
City & S. Lon. Rly.	July 31	2,984	—171	5	11,819	— 699	6½	—
Dublin—Lucan Rly.	Aug. 5	177	+ 45	5	783	+ 109	6½	—
G. N. and City Ry.	,, 6	991	—	25	23,329	—	3½	—
L'pool Overh'd Rly.	,, 7	1,788	—198	6	10,887	— 144	6½	+4½
Mersey Railway ..	,, 6	1,484	— 28	5	7,237	+ 428	4½	—

* Compared with the corresponding period of 1903.

"ZONE" DYNAMOS AND MOTORS.

By HENRY F. JOEL, A.M.I.C.E.

(*Concluded from page* 204.)

In order to ascertain the increase of efficiency and output due to this last described sinuous zone coil winding, Mr. H. M. Hobart, M.I.E.E., suggested that the tests should be made, of which the results are given below; these tests were carried out by Mr. Temperley, of Messrs. J. H. Holmes & Co., Newcastle-upon-Tyne.

The construction described with reference to the two-pole and four-pole motor is carried further into large size dynamos and motors, as shown in figs. 13, 14 and 15, up to 100 to 500 KW. sizes with six poles and eight poles. Indeed, the advantages obtained appear to increase as the sizes of the dynamos and motors are increased, and, owing to the suppression of the local short-circuiting currents under the brushes, and the absence of sparking, the zone construction is particularly adapted for use with dynamos driven by turbines, or otherwise, at very high speeds, say, 3,000 to 5,000 r.p.m. At these high speeds it is practically impossible to construct an ordinary type dynamo, which will collect the current without destructive sparking, but with the zone construction the sparkless commutation of large currents can be practically effected.

Messrs. Newton, Ltd., of Taunton, have been manufacturing machines under licence for the past two years, ranging in size from 1 H P. to 500 KW., designed by Mr. H. St. Hill Mawdsley, M.I.E.E., whose patents also have been purchased by the Zone Dynamo and Motor Patents Co., Ltd.

The following particulars relate to a multipolar machine recently supplied by them to H.M. Office of Works:—

Output: 110 volts, 1,000 amperes, 500 r.p.m. Number of poles, 8. Parallel wound armature. Size of core, 33 in. × 9 in.; air gap, ·25.

Number of armature slots, 132.

Number of armature conductors, 528.

Ampere-turns on field per pole, 3,450.

Ratio of field A.T. to armature A.T., ·82.

Reactance voltage, 3·72.

This machine was tested for six hours at full load, and ran perfectly steadily, and without the vestige of a spark, with fixed brushes from no load to full load; the maximum temperature rise at the end of the run was under 30° F.

COMPARATIVE RESULTS OF TESTS.—"ZONE" ELECTRIC MOTOR WITH ORDINARY TYPE (SALIENT POLE) ELECTRIC MOTOR. NOVEMBER AND DECEMBER, 1902.

Tests made by Messrs. J. H. HOLMES & Co.'s Electrician, at 31, Wilson Street, London, E.C.

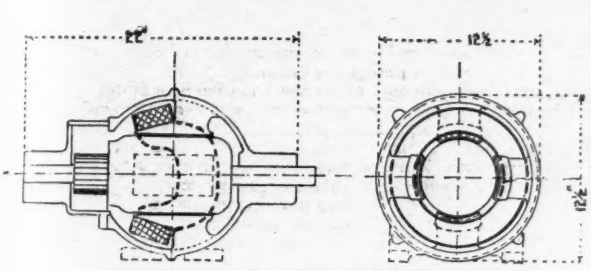


FIG. 11.—"ZONE" ELECTRIC MOTOR

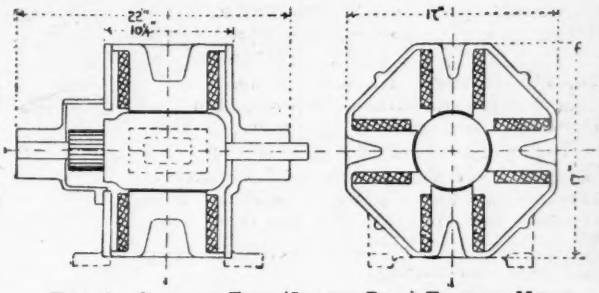


FIG. 12.—ORDINARY TYPE (SALIENT POLE) ELECTRIC MOTOR.

NOTE.—The same armature was used in turn in each field, it having been made interchangeable. The same brushes and brush holder were used in turn in each motor. The field magnets were both made of the same brand of cast-steel, and both had the same pole arc, same number of poles (4), same length of pole, and the same excitation expressed in ampere-turns, *i.e.*, 2,350 ampere-turns.

"ZONE" ELECTRIC MOTOR.

Relative sizes.—As above, both same scale.

Weights.—Copper wire on field coil = 29¾ lbs.
Cast-steel in fields, poles, and casing = 106¼ lbs.
Total weight of motor = 203¼ lbs.

Output.—Safe working, 52 amperes at 100 volts, 1,400 revolutions, at 87·5 per cent. efficiency = 6 B H P.

Sparking Limit.—Calculated (Kapp) 36 amperes, actual 65 amperes.

Efficiencies.—Watts lost in field coil = 56 watts.
Total watts taken to run motor, no load = 446 watts.
Efficiency at 6 B.H P. = 87·5 per cent.

Ampere-turns in field coils, 2,340.

ORDINARY TYPE (SALIENT POLE) ELECTRIC MOTOR.

Relative sizes.—As before, both same scale.

Weights.—Copper wire on field coils = 45 lbs.
Cast-steel in fields and cast-iron at ends = 284 lbs.
Total weight of motor = 386½ lbs.

Output.—Safe working, 36 amperes at 100 volts, 1,370 revolutions, at 84·5 per cent. efficiency = 4 B H.P.

Sparking Limit.—Calculated (Kapp) 36 amperes, actual 45 amperes.

Efficiencies.—Watts lost in field coils (100 v. × ·7 a.) = 70 watts.
Total watts taken to run motor, no load = 530 watts.
Efficiency at 4 B.H.P. = 84·5 watts.

Ampere-turns in field coils, 2,350.

Test made	"Zone" motor, cast-steel field cores.							Standard type single-coil electric motor, cast-steel field cores.							Remarks.
	H P. output.	Revs.	Eff. per cent.	Watts in field coil.	Weights. Copper wire.	Weights. Steel.	Temp.	H.P. output.	Revs.	Eff.	Watts in field coils.	Weights. Copper wire.	Weights. Steel.	Temp.	
					Lbs.		Rise.					Lbs.	Lbs.	Rise.	
November, 1901, and November, 1902.	6	1,400	87	56	29¾	106¼ Total weight* = 203¼ lbs.	93°	1·62 3·6	808 1,665	80·6 82·5	110	42	168 Total weight = 278 lbs.	92°	"Zone" motor—Twice the power, 75 lbs. less weight, 250 revs. slower, and higher efficiency than standard type steel motor.

* With shunt coil weight only 19 lbs., total weight would be 192½ lbs.

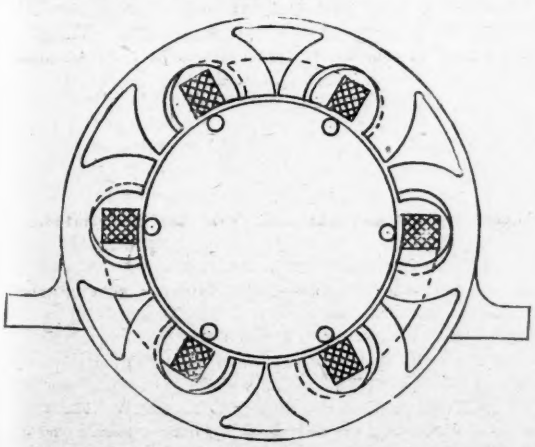


FIG. 13.

Additional tests were made for comparison with a standard type of single coil motor, and the results are recorded in the accompanying table.

Fig. 15 shows a similar machine recently supplied to a central station in the South of England, the output being 500 volts × 120 amperes, 160 r.p.m., the armature being mounted on the shaft of a Diesel engine.

Messrs. Newton find that this construction is peculiarly adapted for variable speed motors, where it is necessary to work with very weak fields at the highest speed.

A 45-H.P., 230-volt motor, built for speeds varying from 240 to 400 r.p.m., ran sparklessly at all speeds, the reactance voltage at 400 r.p.m. being 4·2, and the ratio of field A.T. to armature A.T. being only ·8.

Even when overloaded to give 60 H.P. at the high speed, the sparking was not injurious, the reactance voltage being 5·2, and the ratio of field A.T. to armature A.T. as low as ·65.

In addition to Messrs. Newton, Ltd., of Taunton, Messrs. J. H. Holmes & Co., of Newcastle-upon-Tyne, and also my own firm of Henry F. Joel & Co., London, are manufacturing zone motors under licences from the Zone Dynamo and Motor Patents Co., Ltd. Mr. Henry Edmunds, of Westminster, is the managing director of that company.

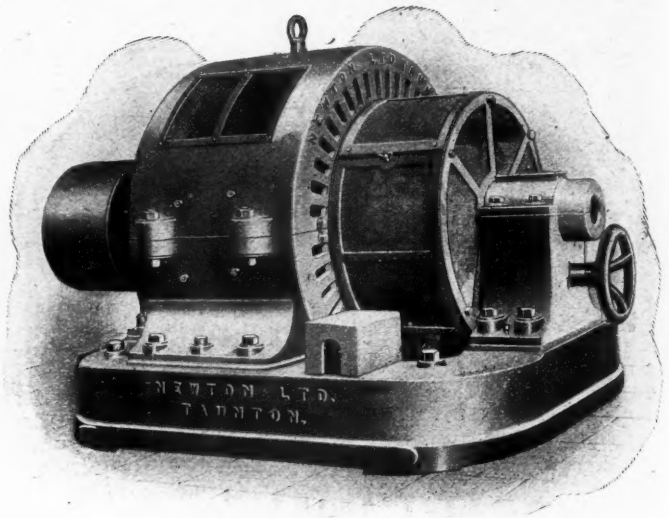


Fig. 14.—"Zone" Dynamos and Motors.

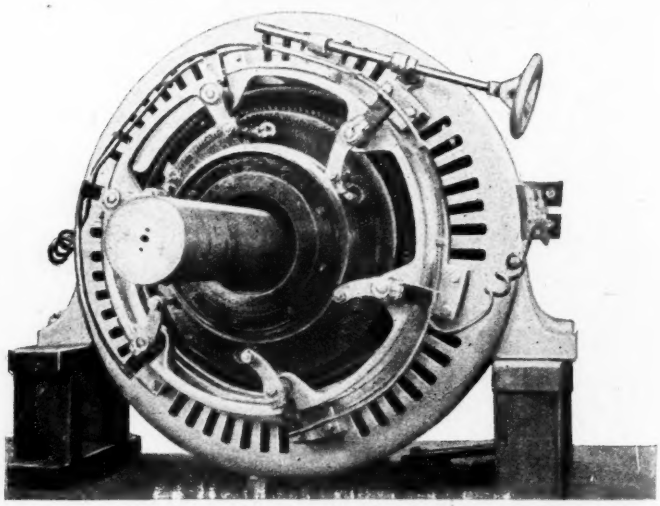


Fig. 15.—"Zone" Dynamos and Motors.

THE COLLIERY EXHIBITION.

(*Concluded from page* 239.)

Cables and Accessories.—Cables and accessories suitable for colliery work were exhibited principally at the stands of the Callender Cable and Construction Co., Ltd., the St. Helens Cable Co., and W. T. Glover & Co. Notwithstanding the fact that many manufacturers consider that the latest rules drawn up by the Departmental Committee, relating to electrical installations in coal mines, need amendment in some particulars, they have lost no time in bringing up their manufactures to the present requirements.

Each of the makers mentioned exhibited a fire resisting cable, its fireproof nature being demonstrated by various means. At Messrs. Glover's stand photographs were shown of a cable submitted to the test of a Bunsen flame, which

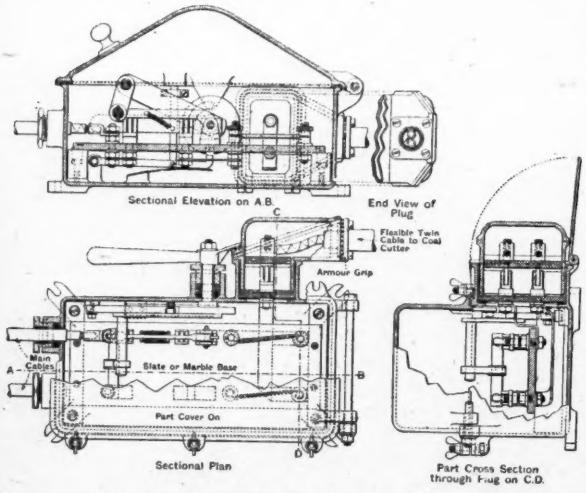


Fig. 25.—Patent Safety Gate-end Box.

apparently had no effect upon the cable. A small kinetoscope showed an arc playing on the outside of the cable without doing any damage to it. One of the special features shown by Messrs. Glover, was a special non-metallic armouring as applied to portable and trailing cables for use in connection with electric coal-cutters and other portable gear. The covering consists of leather strips plaited or braided on the outside of the cable in such a way as to form a very flexible protection, whilst retaining the well-known durable qualities of leather. In addition to cables of various sizes and patterns, insulated with vulcanised rubber, paper and bitumen, water-tight joint boxes and other such accessories necessary for underground work were shown. The paper cables manufactured by this company appear to be much drier than some other patterns, and do not "bleed."

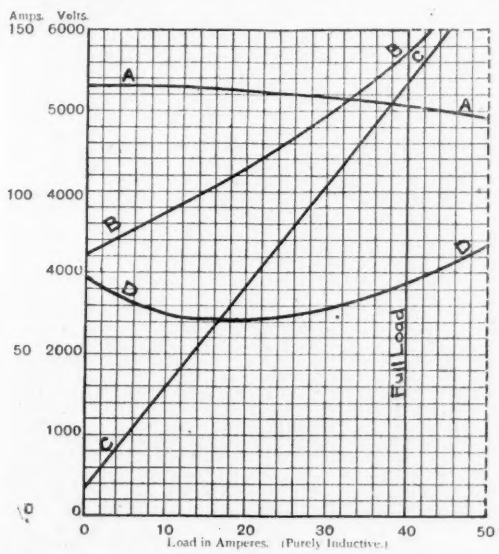
The St. Helens Cable Co. pin their faith to "Dialite," and had a very interesting exhibit of cables insulated with this special preparation. This is said to make an absolutely non-hygroscopic dielectric, and is capable of withstanding temperatures up to 350° F. A lead sheathing is not needed except where mechanical protection is required. A cable subjected to high-pressure was shown immersed in a glass tank of hot water to demonstrate the water-proof nature of the insulating material. Methods of supporting the cables were shown, cables being hung from sprags by means of leather thongs, and a very effective support for armoured pit cables was also shown. (See fig. 24.) This consists of a tapered wrought-iron stirrup, containing a split wood plug bored to a suitable size to receive the cable. The iron sheathing of the cable is first opened out and laid over the top edge and sides of the conical wood plug, which, together with the cable, is then dropped into the iron support. The weight of the cable is thus taken by the sheathing, the centre opening round the cable being filled with bitumen. We have had experience with this type of suspension, and have found it to be quite satis-

factory. Our readers will remember that an arrangement almost identical with this was described by Mr. T. C. Futers in our issue of August 21st, 1903.

Water-tight joint boxes, cable fittings and switches were also shown, a special feature being an enclosed water-tight gate-end switch suitable for fiery mines. There are several ingenious points about this switch, which is so constructed that it is impossible for anyone to remove the lid of the switchbox without first opening the circuit, and the circuit cannot be closed again until the lid is replaced; it is also impossible to disconnect or connect up a trailing cable whilst the switch is on. Fig. 25 shows details of this switch.

The Callender Co. had an elaborate display, including a sectional model of a pit shaft, in which various methods of suspending and supporting mining cables were demonstrated. A room was also fitted up to represent an underground working, cables being fixed or suspended in various ways to the roof and sides.

A special form of clip has been recently introduced by this firm to meet the new mining rule regarding the suspension of cables. By this rule the cable must be so suspended that it will easily fall away from the support in the



A, Pressure at terminals; B B, Resultant excitation; C C, Excitation from series transformer for the compounding; D D, Excitation from shunt transformer.

Fig. 26.—Results of Compounding Test.

event of a fall of roof. The clip consists essentially of two parts, namely, a spike hanger which is driven into the wall or prop, and a clip which is hung with the flexible jaws pointing in the direction of a "fall," so that in the event of anything falling down on the cable it would be forced out of the jaws.

Among other accessories shown was the Callendar-Ward fuse box, the essential feature of which is that the opening of the box switches off current from the circuit. The fuse clips are carried by the hinged lid, so that when the box is opened a fuse can be replaced without fear of touching any live parts.

A variety of water-tight boxes suitable for underground work was exhibited.

An enclosed switch, shown by Messrs. Davis & Son (Derby), Ltd., has some points of novelty. This has also been specially designed to meet the new mining regulations, and is illustrated herewith (fig. 28). It will be seen from the illustration that the switch works on the toggle principle, giving a very quick and wide break on opening the circuit.

Miscellaneous.—There were many exhibits of a somewhat general nature, having no special connection with colliery work. Mention might be made of an over-compounded three-phase revolving-field generator at the stand of Messrs. Witting, Eborall & Co. This is wound on the Heyland system, and is designed to give constant voltage at the far end of a line for all loads, irrespective of the power factor. The field coils are connected up to form four or more parallel circuits, the free ends being taken to the segments of a commutator fixed on the shaft. This commutator takes the place of the usual slip-rings and direct coupled exciter. The segments are interconnected by low-resistance metal strips. The function of the commutator is to convert the three-phase current into a uni-directional one in the field

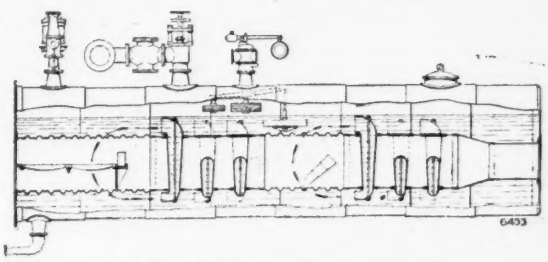


Fig. 27.—Boiler Circulators.

windings. Absolute sparklessness, perfect parallel running, and any desired degree of compounding are the advantages claimed for this machine, together with a constant bus-bar voltage on a varying inductive load. The curve (fig. 26) shows the results of a compounding test. Controllers and high pressure switchgear of the oil-break type were also shown by this company, the latter being of very massive construction. The contacts are of the vertical cone type, the cone being of gun-metal. The contact fingers are of springy copper, with heavy copper faces, and are readily renewable. The density of current on each face is about 100 amperes per sq. in. The insulators are of porcelain, corrugated where outside the oil case to present long leakage surfaces. The whole of the working parts are immersed in a single oil tank of sheet zinc lined with teak, the tank being sub-divided into three divisions by means of teak partitions.

In the Boiler Section, Messrs. Babcock & Wilcox, the Stirling Boiler Co., Messrs. Meldrum Bros., Ltd., and Messrs. Cochran & Co., all had interesting exhibits, and we might refer briefly to the apparatus shown at the stand of Circulators, Ltd. This is an apparatus designed to promote longitudinal circulation in cross-tube boilers of the Lancashire type. The apparatus, which is shown in fig. 27, consists essentially of a series of hoods fixed at the top and bottom of the cross tubes by means of bolts passing through the tubes. A glass model of the arrangement was shown, by which it was seen that the water passing up through the tubes was driven longitudinally along the outer surface of the

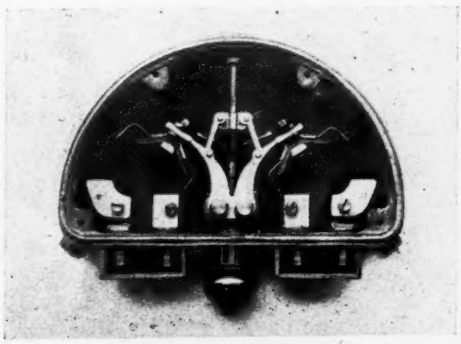


Fig. 28.—Davis Enclosed Switch.

flues, tending to clear the latter of steam and to promote evaporation. The oblique arrangement shown in the flue is a patent "'deflector' for regenerating the flue gases." By its use a saving of 6 per cent. in fuel consumption is said to be effected. According to tests that have been made on an Adamson boiler 20 ft. long, with two cross-tubes in each furnace, the evaporation from and at 212° F. was without the circulator 8·04, and with the circulator

8·59 lbs. According to a 9 hours' test on a 30 ft. × 7 ft. 6 in. Adamson boiler at the Islington Electricity Works, the evaporation was increased by 10·6 per cent., and at the Leyton Public Baths on an 8 hours' test an increase of 15·1 per cent. was effected.

From every point of view the Exhibition appears to have been a success, and it is to be hoped that the result will be to stimulate the application of electricity to colliery work.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"E. H. H." writes:—"I should like to have the opinion, and, if possible, reference to precedents from your legal contributor on the following.

"1. Mains have been laid in certain places under a provisional order. Street improvements have subsequently been undertaken involving the removal of disconnecting boxes, and, of course, the cables with them. Who is legally responsible for the cost of such removal? In my case the parties are the Highways and Electricity Departments of a Corporation, but the argument should, I think, apply if a supply company and local authority were concerned also.

"2. I find under the Acts numerous references to mutual notice giving in the case of gas, water and electricity undertakings, but am not able to find a reference to any obligation on the part of a street authority to notify gas, water or electricity undertakers of their intention to open up or alter streets, sewers, &c. I think there is a ruling that the street authority own the surface only, and equitably an obligation seems to lie on them to notify undertakers and reimburse them for any damage, &c., due to opening.

"I refrain from further remark, and await comment with interest."

*** It is quite clear from the provisions of the Electric Lighting (Clauses) Act, 1899, Sec. 17, that if the highway authority desire to alter the position of or otherwise deal with mains already laid, they may do so at their own expense, the cost in case of difference to be settled by arbitration. The Act provides that anybody or person may alter the position of any electric lines or works of the undertakers being under any street which may interfere with the lawful exercise of any powers vested in that body or person in relation to that street or place. They must, however, give one month's notice of their intention, describing the proposed alterations, together with a plan showing the manner in which it is intended the alterations shall be made, and shall upon being required to do so by any such owners, give them any such further information in relation thereto as they may desire. In settling any question as to the compensation which should be paid, an arbitrator must have regard to any duties and obligations which the owners may be under in respect of the pipes, wires, electric lines, or works, and may, if he thinks fit, require the operators to execute any temporary or other works, so as to avoid interference with any purpose for which the pipes, &c., are used so far as possible. It is also competent for the owners of the pipes, &c., if they think fit to elect to do the work themselves, and recover their expenses from the operators.

The principles above enunciated also apply in cases where the supply of electric light is in the hands of a private company. In such a case the highway authority is bound to reimburse the cost of the removal to the company.

As to the second question, it would seem that "E. H. H." has overlooked Sec. 18 of the Electric Lighting (Clauses) Act, 1899, which relates to the laying of electric lines, &c., near sewers, &c., or gas or water pipes, or other electric lines. That section provides that any electrical, gas, or water company shall, unless it is otherwise agreed between the parties interested, or in case of sudden emergency, give to the local authority, or to the gas, electric supply, or water company (as the case may be), not less than three days' notice before commencing to dig or sink any trench. This notice may only be dispensed with in cases of great emergency. It is conceived that a reference to the exact terms of this section will provide "E. H. H." with a satisfactory answer to his second question.

A New Carbide Factory.—It is announced that a new factory for the manufacture of calcium carbide is about to be erected at Innsbrück, in the Tyrol. An amount of power equal to 8,800 H.P. is to be purchased at the price of 150,000 kronen from the electricity works belonging to that town. The new factory will not be far from the existing carbide works at Matrei, which has been in successful operation for some years.

THE ADAPTABILITY OF ELECTRICAL DRIVING.*

By B. LONGBOTTOM.

(Concluded from page 211.)

For the sake of following out our argument by a progressive method, we have taken a certain indicated horse-power at the engine, and worked downwards to the net result afforded by the two systems. In comparing an actual case, however, our fixed quantity would be the brake-horse-power required in the works, and we should work backwards from this to the indicated horse-power or quantity of steam required by the two systems, which would give the relative cost of generation for the same result. In order to do this, we should have to plot out the input-output curves for the combined plant and cables, as well as for the motors. This can easily be done from the tables of efficiencies given, but it would unnecessarily prolong the paper to do it here.

It is evident that our example will be improved if larger plants are considered, and the following example, which has been worked out by the latter method, may be of interest.

It is assumed that from indications taken of the existing engine, it was found that 400 effective brake-horse-power was required to drive the machinery. Then, taking the case where three-quarters and one-half of the whole plant is in operation, we get the following:—

Proportion of plant working.	Full.	¾	½-load.
Effective horse-power required by machines	400	300	200 B.H.P.
Frictional losses between machines and motor-shaft...	40	40	40 B.H.P.
Brake horse-power at motor-shaft	440	340	240 B.H.P.
Electrical input, assuming 10-H.P. motors working at ¾-load ...	518	400	282 E.H.P.
Electrical horse-power at generator terminals, including losses in cables	537	410	285 E.H.P.
Indicated horse-power of engine	615	485	356 I.H.P.
Against—			
By mechanical transmission, assuming frictional losses equal to 13 per cent. of the indicated horse-power of the engine at full-load	700	600	500 I.H.P.
Or a decrease in steam used by electrical distribution of ...	12%	19%	29%

It is also worthy of notice that with electrical distribution the size of the prime-mover is reduced from 700 to 615 I.H.P. if the plant is working at full-load, and from 600 to 485 I.H.P. if the plant is working at ¾-load, so it is apparent that in electrical driving a smaller prime mover can be employed, resulting in a saving that will go towards defraying the cost of the electrical plant.

In my opinion the foregoing tables will afford a ready means of comparison if a change is contemplated from mechanical to electrical distribution, as it will only be necessary to compile a proposed electrical plant on similar lines to the examples submitted, and compare the efficiency with the result of the indications of the existing engine.

It is now generally recognised that where machines are in constant use, provided they are below a given horse-power—say 5 H.P.—grouping is the most desirable. This method most successfully overcomes the great variation of power that is experienced in the driving of small machines, and is naturally more efficient than if a number of smaller motors were employed, on account of the necessarily lower efficiency (see Table No. III.), as well as more economical in first cost and up-keep.

The greatest care, however, must be taken that too many machines are not driven from one motor, and that they are not spread over too big an area, as this would only entail additional shafting, counter-shafts, and belts, resulting in the distribution losses being greater than was the case with the system of engine and shafting. In Table IV. the bad examples of group-driving were purposely printed in italics, and in test No. 5 it is seen that a 7½ B.H.P. motor, when driving three machine tools through 42 ft. of line-shafting, entails a loss of 10·5 per cent., whereas a similar sized motor, driving five machine tools through 150 ft. of line-shafting, shows a loss of 60 per cent. absorbed by friction. But if a proper system of motor units is employed, there is no difficulty in obtaining a high efficiency. In the average engineering works, 5 B.H.P. can be taken as the smallest unit to be used, except in special cases of isolated machines, or machines used for intermittent working. This motor has an efficiency of 82 per cent. at ¾-load, and can, therefore, be looked upon as an efficient power unit. In the majority of cases, the other useful power units can be taken as 7½, 10, and 15 B.H.P., and only in works where very heavy materials are handled will it be found necessary to have larger units, except, of course, for individual machine-driving.

Now that it has been shown that the efficiency of electrical distribution compares favourably with that of mechanical distribution, there yet remains certain advantages that cannot be overlooked.

It is of the greatest importance that machinery and departments should be arranged with a view to economical and increased output,

* Abstract of paper read before the Manchester Association of Engineers, March 26th, 1904.

and it is now no longer necessary to arrange the machinery in parallel lines down the works, so that it can be driven from line-shafts supported from the main girders, as is the case with the best arranged mechanical distributions.

Lighter structures can be used resulting in a material reduction in the cost of the building, thus further defraying the cost of the electrical plant.

Then the advent of portable machine tools, and other labour-saving devices, has been rendered more possible by the electric motor, and the economies to be obtained by these methods of manufacture are daily becoming more apparent.

Again, in new works there is always a danger with mechanical distribution of the power plant becoming too small as the business increases, with disastrous results as far as further development is concerned; but an electrical system is perfectly elastic, it being only necessary to put down another generating unit and an additional panel on the main switchboard, and this can be done without in any way affecting the efficiency of the existing plant.

It is now possible for the smallest user to obtain electricity for power purposes at a price varying from 1d. to 2d. per unit, and this must be of vital importance to young firms who require their available capital for other useful purposes.

As a conclusion to this paper, I thought that a set of tables giving the fuel cost of generating electricity by direct-coupled steam or gas-engine sets, would be of interest, if only to show the figures that our steam and gas engineers are prepared to guarantee.

FUEL COST OF ELECTRICAL ENERGY.

TABLE V.—SLOW-SPEED HORIZONTAL AND VERTICAL CONDENSING ENGINES. DIRECT COUPLED.

I.H.P. of engine.	Lbs. of steam per I.H.P.-hour.			Total lbs. of steam per hour.			*Total lbs. of coal per hour.			† Cost of coal per hour, pence.			Output of generator, kilowatts.			Cost of current per B.T.U., pence.		
	Full.	¾	½	Full.	¾	½	Full.	¾	½	Full.	¾	½	Full.	¾	½	Full.	¾	½
25	15	17	19	375	320	258	54	46	34	2·9	2·5	1·8	14·7	10·6	6·4	·197	·236	·283
50	14½	16½	18½	725	620	462	104	89	66	5·6	4·8	3·5	30	22	13·2	·187	218	265
100	13½	15½	17½	1,350	1,160	875	193	166	125	10·3	8·9	6·7	60·5	43·5	26	·17	·204	·258
250	13	15	17	3,250	2,820	2,120	465	405	303	25	21·7	16·3	155	110	68	·162	·197	·24
500	12½	14½	16½	6,250	5,450	4,130	890	780	590	48	42	32	308	218	130	·156	·193	·246
1,000	12	14	16	12,000	10,500	8,000	1710	1,500	1,140	92	81	61	620	440	265	·148	·184	23

*7 lbs. of steam per lb. of coal. † Coal at 10s. per ton. Steam pressure 150 lbs. per sq. in.

TABLE VI.—HIGH SPEED VERTICAL CONDENSING ENGINES. DIRECT COUPLED.

I.H.P. of engine.	Lbs. of steam per I.H.P.-hour.			Total lbs. of steam per hour.			*Total lbs. of coal per hour.			†Cost of coal per hour, pence.			Output of generator in KW.			Cost of current per B.T.U.		
	Full.	¾	½	Full.	¾	½	Full.	¾	½	Full.	¾	½	Full.	¾	½	Full.	¾	½
25	21	21·5	22·5	525	403	282	75	58	40	4	3·1	2·2	15	10·7	6·4	266	·29	·344
50	20	20·5	21·5	1,000	770	538	143	110	77	7·5	5·9	4·1	31	22·4	13·6	·242	263	·3
100	19	19·5	20·5	1,900	1,460	1,025	272	210	147	14·5	11·2	7·9	62·5	45·5	28	·232	·246	·282
250	17·25	17·75	18·7	4,320	3,330	2,340	618	477	335	33	25·5	18	161	107	72	·205	·238	·25
500	16·5	17	18	8,250	6,380	4,500	1,180	910	644	63	48·5	34·5	326	236	149	193	·214	·232
1,000	16·0	16·5	17·5	16,000	12,370	8,750	2,290	1,770	1,250	133	95	67	655	475	298	·203	·2	·225
1,000	13·5	14	15	13,500	10,500	7,500	1,910	1,500	1,070	103·5	80·5	57·5	645	467	290	·161	·172	·198

BASIS.—* 7 lbs. of steam per lb. of coal. † Coal at 10s. per ton. Steam pressure, 150 lbs. per sq. in.

TABLE VII.—GAS ENGINES. DIRECT-COUPLED.

I.H.P. of engine.	Town gas (heat value, 700).							Producer gas.							Cost per B.T.U. in pence.								
	Cubic feet per I.H.P.-hour.	Total cubic feet per hour.			Cubic feet per kilowatt-hour.			Lbs. of fuel per I.H.P.-hr.	Total fuel per hour (lbs.).			Lbs. of fuel per kilowatt hour.			* Town gas.			† Dowson gas. Anthracite coal.			§ Mond gas. Bituminous coal.		
		Full.	¾	½	Full.	¾	½		Full.	¾	½	Full.	¾	½	Full.	¾	½	Full.	¾	½	Full.	¾	½
30	13	374	296	231	24·9	26·1	30·8	·93	26·7	21·2	16·5	1·78	1·88	2·2	6	·63	·74	·238	·252	·295	·057	·06	·071
45	12·5	575	460	356	23	24·5	28·6	·9	41·4	33	25·7	1·65	1·76	2·06	55	·59	·69	·221	·236	·276	·053	·057	·066
90	12	1,095	875	670	21·9	23·3	26·8	·86	78·5	62·7	48	1·57	1·67	1·92	·53	·56	·64	·21	224	·257	05	·054	·062
175	12	2,130	1,700	1,296	21·3	22·7	25·8	·86	152·5	122	92·5	1·52	1·63	1·85	·51	·54	·62	204	218	248	049	052	·059
500	...	...	...	...	...	...	...	·75	391	316	241	1·32	1·4	1·61	...	...	...	177	188	·216	·042	045	052
1,000	...	...	...	...	...	...	...	·75	780	623	478	1·3	1·38	1·59	...	...	...	·174	185	213	042	·044	·051

BASIS.—* Gas at 2s. per 1,000. † Coal at 25s. per ton. § Coal at 6s. per ton.

The steam tables have been compiled from data kindly supplied to me by Mr. George Saxon and Mr. W. Stead, and the gas-engine table from data received from Mr. H. N. Bickerton, to which gentlemen I take this opportunity of conveying my best thanks.

Tower Wagons.—The tenders of Messrs. S. Rawlinson and Sons, Blackburn, have been accepted for Tower wagons of the screw elevating type, by the Brush Electrical Engineering Co., the Swindon Corporation, and the Derby Corporation.

REVIEW.

Electric Lighting and Power Distribution. Vol. II. By W. PERREN MAYCOCK, M.I.E.E. Whittaker & Co. 7s. 6d.

The volume before us is, as described in the sub-title, an elementary manual of electrical engineering, suitable for students preparing for the preliminary and ordinary grade examinations of the City and Guilds of London Institute. It necessarily covers a fairly wide range, and is dealt with in the author's well-known style.

In the early portions of the book, the principles of the dynamo-electric machine are fully described, and calculations of magnetic and electric parts are gone into as fully as is desirable in a book of this description. Illustrations of typical machines are given, these including many well-known types.

Following this section of the book is a chapter on electricity meters, those in common use being described in detail, including prepayment meters and maximum demand indicators. Most of this chapter is, of course, based upon makers' descriptions and is fully illustrated.

Following this, the author treats of electric motors, first of all describing the general principles, and giving the usual rules for finding the direction of motion. Questions of torque, speed and power are explained, and the essential differences between shunt and series motors are given. Starting and regulating switches also receive adequate treatment. In this chapter are alternating current motors, both of the single and polyphase types; illustrations of well-known designs and types are shown.

In Chapter XV. is a fairly comprehensive treatment of accumulators, the general principles being first of all explained, and afterwards various types described and illustrated. Diagrams of switchboards in which accumulators are included are also given, and the method of employing boosters for charging is shown.

Chapter XVI. treats of transformers, and the same method is followed, namely, of first describing the general principles, and afterwards showing the various ways in which transformers are used. In this chapter are also included rotary transformers or motor-generators, and reference is made to the Nodon valve and the Cooper-Hewitt rectifier. Ferranti's rectifiers are also fully described and illustrated.

In Chapter XVII. we have a *résumé* of the systems employed for transmitting electrical energy from generating stations, including the general arrangement of the switchboard, and a few pages on cable laying.

The book is well illustrated throughout, there being no fewer than 407 figures in a book of 673 pages. The descriptions throughout are generally clear, and where the author keeps to those points with which he is familiar, the matter is fairly accurate. For much of the information he has necessarily had to rely upon the makers of the various apparatus described, and it is chiefly in those portions of the book dealing with practical points in the application of dynamos and motors to common purposes that the author gets seriously astray. On page 8 we find a sentence which is met with in most books of this nature, to the effect that series-wound dynamos are generally used for series arc lighting. This expression has been handed down from book to book, copied and re-copied, by various authors, whereas modern every-day practice falsifies the statement. The author himself, on page 9, contradicts it, by saying :—"Special dynamos for series arc lighting are not very much used nowadays, the general practice being to run the lamps in series groups of 2, 3, 4 or more, off the ordinary constant potential mains." Why repeat, then, the effete expression, "Dynamos for series arc lighting are generally series-wound"?

On page 11, the usual and absurd hairpin characteristic curve of a shunt dynamo is given, although the author tells us that, in this instance, the lower half of the hairpin is based on imagination, and not on observation. In giving various diagrams of connections for machines connected in series and parallel, the author shows two series dynamos in parallel, and describes the method of paralleling them. The equalising switch is connected between the brushes of the two machines at the armature ends of the series coils, just as is done in compound-wound machines. When one machine is running, it is necessary, so the author tells us, to close the equalising switch, causing part of the current to flow through the field of the stationary machine, which can then be run up to speed and switched into circuit. He appears to overlook the fact that, the moment the equalising switch is closed, the pressure of the running machine will drop to half its voltage, and all the arc lamps on this machine circuit will go out. The only way in which two series-wound machines could be satisfactorily run in parallel would be by coupling them rigidly together, and connecting them electrically, so as to work the two machines as one.

The next mistake we notice is on page 40, where a description is given of a method of running compound-wound dynamos in parallel. The author tells us that the compound coils must be short-circuited before the machines are paralleled, and the short circuit removed afterwards. He further tells us that compound-wound dynamos are rarely used in series. All this, of course, is pure nonsense. All that is required is an equalising switch for two machines, or one for each machine when there are more than two. As to the other point, compound-wound machines are very frequently used in series. Then we are told, a few paragraphs further on, that there is a liability for the dynamo to reverse when the magnets are made of wrought-iron, owing to the low retentivity of the iron. It is, obviously, impossible for any dynamo to reverse itself, no matter how soft the iron.

On pages 53 and 54 an elaborate calculation is given for finding the "total resistance" of an armature winding. It is, of course, quite impossible to measure this resistance in a closed circuit armature, the resistance measured between the brushes being a quarter of the value in question. It is difficult to see, therefore, why he uses the term "total resistance," and goes to such trouble in showing how to calculate it.

In discussing the heating of dynamos, the author rightly says that overheating may take place in an armature when no current is being taken from it, owing to the short-circuiting of a coil to the armature core, due to defective insulation. He might also have added that the heating would take place just the same if the coil became short-circuited on itself, although the insulation of the core might be intact.

The author, on page 60, says that high-speed engines are best for direct coupling. High speed is, of course, a relative term, and depends also upon the size of the machine; there are a good many central station generators running at what is a comparatively low speed, say, 90 r.p.m., this applying more particularly to large traction generators.

On page 70 is given a "Hydraulic Analogue to Illustrate an Alternating Current;" a small water-wheel is shown in the closed circuit of a pipe filled with water, and we are told that if this water-wheel be rotated first in one direction and then in the other, the flow of water in the pipe will be first in one direction and then in the other. This would certainly not be the case with the arrangement shown, in which both inlet and outlet are from the tips of the blades. In fact, there would be no motion of water whatever in the pipe, no matter which way the wheel revolved. The analogy criticised by the author on page 74 is, if not a good one, certainly better than that given in the book under notice.

A Parsons alternator may have two poles, although the author on page 167 limits it to four poles. In fact, the wording makes it appear that any Parsons alternator must necessarily be a four-pole machine.

The author's explanation of torque, on page 321, is incorrect, as in the equation given to represent torque there is no expression for the radius of the armature; the author, in fact, draws no distinction between torque and tangential force, and therefore goes entirely astray.

In discussing motors, too, the author occasionally gets a little beyond his depth, this applying more particularly to his description of compound wound motors, so called, in which the series winding is opposed to the shunt. He discusses at some length the disadvantages of this arrangement, finishing up in the usual way of inexperienced authors by saying that compound wound motors are not much used. As a matter of fact, compound wound motors are very largely used, but the series winding helps the shunt, as it does in the compound wound dynamo.

What, by the way, does the author mean on page 333 by a "separately excited motor?" Surely all motors are separately excited; we have yet to see one which is self-excited.

Dealing with three-phase motors, the author gives a somewhat lengthy explanation of the method of reversing the direction of rotation. Thus, on page 427, we have the following :—"With a 3-phase motor, two of the phase connections must be interchanged, and the connections of their field windings reversed. Thus if in fig. 239 we change poles 2 and 5 over from phase C to phase B, and poles 3 and 6 from phase B to phase C; and at the same time reverse the connections of the field windings so as to reverse the polarities, we shall get a reversal of rotation." What a very complicated process it seems! But the student need not be alarmed, as, in practice, all that is necessary is to reverse two of the three line wires, and the thing is done. As to starting a three-phase motor, this is not quite so simple as would appear from the author's explanation on page 425, namely, the method of placing a choking coil in each phase circuit of the field. When this is done, the chances are that the motor will not start at all against a load until most of the choking coil is cut out, as, under these conditions, the current necessary to start the machine may be from three to six times the full running current, owing to the fact that the torque of the motor is reduced in proportion to the square of the impressed voltage.

On page 558 a diagram and description of a feeder booster are given, that is, a booster intended to make up for the drop in voltage at the end of a long feeder. The author

clearly does not understand the method in which series-wound boosters are used. A series-wound motor is shown connected in one of the feeders. This drives a shunt-wound dynamo, which is joined across the lines. At first sight it looks as if there were a mistake in the diagram, and that the booster is on the wrong side of the motor. But no, it is quite as intended by the author, who thus describes the action :—"Here the self-regulating action of the booster will be apparent. The greater the current drawn through the feeder cables, the greater will be the tendency for the pressure to drop; but the machine will counteract this tendency, as its speed will increase with the current."

To show the absurdity of the arrangement, we have only to consider what will happen when no current is passing down the feeder. The series motor and the generator will be, according to the author's argument, at rest, the armature of the latter short-circuiting the feeders. Again, as the motor gets up speed it will put a back E.M.F. in the feeder circuit. As a matter of fact, it will not act as a motor at all, but as a back E.M.F. generator, driven by the shunt machine, and will thus lower instead of raise the voltage.

Most of the inaccuracies pointed out above would not be obvious to the ordinary student, making it all the more necessary that attention should be called to them, seeing that the book is intended to prepare students for examinations.

Throughout the book we find repeated references to other books by the author. This would not be objectionable if the author gave other references as well; for example, in discussing the maximum demand system, the reader is referred to the author's articles on the subject in the ELECTRICAL REVIEW; at least, he might have been referred, also, to the writings of the originators of this system. The value of the book would have been greater, had the author confined himself to those portions of his subject with which he is acquainted.

PRACTICAL ELECTRICAL TESTING IN THE NAVY.

BESIDES the electric light installation and such permanent circuits as bells, telephones, and fan circuits, with which a modern battleship is now equipped, there are a great many temporary electrical fittings which have to be rigged up from time to time in order to serve an immediate purpose, after which the whole system is taken down, pulled to pieces, and stowed away until it is next required, either to perform the same duty as before, or a totally different one, as necessity arises.

The torpedo staff on board ship have a certain fixed allowance of stores supplied for definite purposes, and with these stores they must make shift to do whatever may be required in the electric line.

Thoroughly imbued with the healthy spirit of departmental rivalry, the torpedo lieutenant considers it a point of honour with his staff and the torpedo school to uphold the tradition that the word "can't" is not to be found in the seaman's vocabulary; and, before all things, it must be remembered that the torpedo lieutenant is a seaman. Thus it is that he is often hard put to it, in the endeavour to make bricks without straw.

In such difficulties, and under similar circumstances, have the members of the staffs in the torpedo schools *Defiance* and *Vernon* been situated; and to their judgement the modification and selection of instruments and gear most suitable for use at sea are due. To begin with, every piece of electrical gear, and every instrument supplied by the contractors, have had to undergo examination, and in most cases a practical test, by a naval officer attached to the Yard, before they are passed as fit for use on board ship.

Thus, all electric cables have been accurately tested for insulation and continuity shortly before issue, and the results in megohms and fractions of an ohm, respectively, noted in a book which holds the complete history of each individual cable.

The cables are usually made up in drums containing lengths of 1,000 yards, and in this manner they are stowed in their appointed places.

Henceforward actual measurement practically ceases, the knowledge of its value between certain limits being all that is required for practical purposes.

Tests are always applied in a certain order, for obvious reasons which exclude the necessity of doubtful conclusions.

There are three general tests invariably applied before a circuit that has just been fitted is considered complete; these are :—

1. Test for non-contact in order to ascertain that there is no direct short circuit.

2. Test for continuity to make sure that with the switch on there is a complete circuit.

3. Test for insulation which shows that the insulation is sufficiently good for practical purposes.

For these tests a form of Daniell cell is used, permanently connected with a galvanometer. That used for the first two tests is of the Minotto form, consisting of a cylindrical ebonite container some 5 in. deep by about 4 in. diameter; into the bottom of this is placed a shallow copper dish of the shape of a flat box with a lid, and with a circular hole cut in the top. This dish is packed with crystals of copper sulphate, and it will be noticed that the construction of this copper element admits of considerable tilting of the cell before there is danger of the solution of copper sulphate reaching the zinc plate above.

Over this copper dish is then placed a large disk of felt or fearnought, an insulated lead having been soldered to the copper and led up to the top of the container along the side of the latter. The cell is next packed with coarse grain sawdust to a depth of about 3 in., another fearnought disk is placed over this, and a substantial block of zinc surmounts the whole.

An ebonite top fits nicely into the container, and leads insulated with rubber are brought up through holes to terminals, the copper going to a thumb screw, while the zinc lead terminates in the nipple of a key.

Held in by two screws, the galvanometer fits into a circular recess cut in the lid; it has terminals on either side of its brass case, so that it can be entirely disconnected from the cell if required to be used separately. In the ordinary course of affairs one terminal is joined by a short lead to the base of a key corresponding to the nipple in connection with the zinc. We have now a complete circuit from the free terminal of the galvanometer, when the key is pressed, through the cell to the terminal attached to the copper dish.

The whole is mounted in a leather case, with a shoulder strap for portability.

When required for use the cell is taken apart, the sawdust saturated with water and replaced, and the free terminals are put on short circuit, with a piece of metal under the key for half an hour, during which time a feeble current, due to local action, will have separated some of the copper out of the weak sulphate solution, and dilute zinc sulphate will be left in contact with the zinc.

The connection between the free terminals is now broken, and the cell is ready for any work it may be called upon to perform within the next six months, after which period a fresh supply of copper sulphate and new clean sawdust will be required; all traces of a copper deposit also should be scraped from the zinc block.

The variety of uses to which such an instrument may be put is astonishing considering its simplicity; it makes a good practical standard of voltage, giving an unimportant fraction over unity, while it can be used to furnish a minute but steady current. The galvanometer consists of an ordinary magnetised needle moving within a flat coil of 20 ohms resistance, and pivoted between jewels; a pointer of ebonite moves over a graduated face, and thus gives some idea of values, though, being equally divided, the reading is not strictly direct. When newly charged, a swing of 80° should be shown on short circuit, and under these conditions the combined internal resistance of galvanometer and cell should be about 50 ohms, the resistance of the cell varying in accordance with the degree of saturation and depth of sawdust; this may be anything between 20 and 40 ohms.

And now as to the special applicability of such a cell for naval purposes: first and foremost it must be capable of testing detonators without the slightest danger of firing them, for, under circumstances of war, one cannot afford to have a miss-fire due to defective fuses or bad connections, and

circuits actually fitted ready for service must be tested as they stand.

It requires about ½-ampere to heat sufficiently the wire bridge in the various descriptions of naval fuse, and therefore the margin of safety is ample, seeing that, under the most favourable conditions, the cell is only capable of putting out $\frac{1}{40}$th.

The next thing to be inquired into is the sensitiveness of the instrument; this, again, is simple, for a perceptible deflection is created through 1,000 ohms external resistance, whereas, in all ordinary work, the continuity resistance should lie within about 10. Hence, in testing for continuity, a deflection of at least 70° is required before the circuit is passed as satisfactory.

A permanent magnet is supplied with the instrument, and fits into a little case on the leather strap; by the skilful use of this, inserted in the leather mounting at a position previously marked by trial, the instrument may be rendered considerably more sensitive, the object being, of course, to reduce the controlling field of the earth, and thus a high degree of insulation may be tested.

Again, this combination of Daniell cell and galvanometer comes in handy for testing the efficiency of each individual cell in a battery, in case it should fall under suspicion.

Leclanché cells are universally used in the Navy, and by opposing the E.M.F. of the cell to that of the test battery, a good idea of its condition can be obtained, especially as the deflection being about 45°, the needle is then in its best position for detecting small differences.

Equipped, therefore, with one of these instruments slung over his back, the "seaman torpedoman" as he is designated, can go anywhere, and do most things with a circuit; he can use it as a pole tester, find the entrance and exit of any particular lead in a complicated bell or telephone circuit, which cannot be traced through bulkheads and watertight glands, he can detect any serious fault and form a rough estimation of its extent.

There is, however, another form of test battery which is designed for high insulation testing, such as is necessary for submarine work and mining, where it may be necessary to have a battery of many cells on open circuit for weeks together, and where a comparatively low insulation would result in running the battery down. It consists of a wooden box about the size of an ordinary schoolboy's writing desk, containing six Minotto-Daniell cells of square shape and of about one-quarter the capacity of the cell previously described.

The cells are all joined in series, but each zinc is also connected to a separate brass block in a switch facing the operator, so that any number of cells may be put on, from one to six, as required.

The galvanometer supplied with this box is considerably more sensitive; it has a resistance of 1,000 ohms, and instead of an ebonite pointer, the pointer is in this case made of steel watch spring and magnetised in opposition to the lower one, so as to form an astatic system in part, though the lower magnet is sufficiently strong to preserve a meridional position.

These are the two pieces of apparatus with which almost the whole of the really practical testing in a man-of-war is carried out; they are admirably adapted to the purposes for which they are supplied, and with them, in the cramped quarters of a boat loaded with heavy mines and coils of cable, sharing such scant protection from spray and bad weather as the tail of a seaman's oilskin can afford, knocked about in transportation, yet suffering no material damage, very efficient tests can be swiftly carried out on the spot. They are simple to use in their elementary functions; only the slenderest knowledge of electrical principles is required.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

16,393. "A new or improved automatic electric cut-out switch." E. J. Javaux. July 25th.

16,395. "An improved combined electric switch and lampholder." C. E. Hunter. July 25th. (Complete.)

16,396. "Improved method of producing zinc from sulphate solutions by electrolysis." C. D. Abel. (Siemens & Halske, Act. Ges., Germany.) July 25th. (Complete.)

16,408. "Improvements in and relating to electric circuit controllers, especially applicable in connection with the governing of elastic fluid turbines." The British Thomson-Houston Co., Ltd., The Warwick Machinery Co., Ltd., and F. Samuelson. July 25th.

16,409. "Improvements in and relating to electric measuring instruments." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 25th.

16,410. "Improvements in and relating to electric measuring instruments." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 25th.

16,418. "Improvements in electrically-driven winding engines." A. Raby. July 25th.

16,422. "Improvements in the manufacture of electrical resistances." Electric Equipment & Securities, Ltd., and C. Ruzicka. July 25th.

16,423. "Improvements in the manufacture of electrical resistances." Electric Equipment & Securities, Ltd., and C. Ruzicka. July 25th.

16,424. "Improvements in the manufacture of electrical resistances." Electric Equipment and Securities, Ltd., and C. Ruzicka. July 25th.

16,425. "Improvements in the manufacture of electric incandescence bodies." Electric Equipment and Securities, Ltd., and C. Ruzicka. July 25th.

16,426. "Improvements in and relating to contact breakers for induction coils." F. R. Butt and H. W. C. Cox. July 25th.

16,447. "Improvements in electric switches for use in pole changing." J. Y. Johnson. (Voigt & Haeffner Aktien-Gesellschaft, Germany.) July 25th.

16,479. "Improvements in telephone repeaters." G. W. Kretzinger. July 26th. (Complete.)

16,483. "Improvements in or connected with electric arc lamps." J. Brockie. July 26th.

16,489. "Improvements in or relating to apparatus for controlling electric ignition currents of internal combustion engines." Humber, Ltd., and S. H. Halford. July 26th.

16,509. "Improvements in telephone directories." F. Drowns. (Date applied for under Patents Act, 1901, January 29th, 1904, being date of application in United States.) July 26th. (Complete.)

16,579. "Improvements in incandescent electric lamps." R. A. Gill. July 27th.

16,581. "Improvements in electrical binding screws or terminals." M. Bouchat. (Date applied for under Patents Act, 1901, February 15th, 1904, being date of application in France.) July 27th. (Complete.)

16,595. "Improvements in and relating to supporting devices for electric fans." S. G. Leach and E. Bergtheil. July 27th.

16,601. "Improvements in telephone central station systems." G. Lambert. July 27th.

16,603. "Improvements in or relating to electric arc lamps." A. D. Jones and The Jandus Arc Lamp and Electric Co., Ltd. July 28th.

16,608. "Improvements in or in connection with means for electrically operating type-writing machines." S. H. Heywood. July 28th.

16,613. "Improvements in electric time switches." D. J. Steele and C. Kratt. July 28th.

16,639. "Improvements in electric switches." C. Smith. July 28th.

16,653. "Improvements relating to starting switches for electric motors." Stothert & Pitt, Ltd., and W. Pitt. July 28th.

16,662. "Improvements in electric motor-control systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 28th.

16,663. "Improvements in electric meters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 28th.

16,664. "Improvements in starting resistances for electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 28th.

16,667. "Improvements in arc lamps." W. R. Ridings. July 28th.

16,718. "A self-acting guide for trolley-wheels of electric cars to facilitate catching the overhead line in the groove of the trolley-wheel." A. Berkshire and P. B. Walsh. July 29th.

16,728. "Improvements in compounding dynamo-electric machines for three-wire systems." Allgemeine Elektricitats-Gesellschaft. (Date applied for under Patents Act, 1901, July 31st, 1903, being date of application in Germany.) July 29th. (Complete.)

16,729. "Improvements in contact-shoes for electrically-propelled vehicles." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 29th.

16,768. "Improvements in or relating to electrolytic electricity meters." C. O. Bastian. July 29th.

16,762. "An improved method and means for joining together the ends of telegraph wires and the like." G. E. Schmidmer. July 29th. (Complete.)

16,764. "Improvements in electric switches." J. Y. Johnson. (Voigt and Haeffner Aktien-Gesellschaft, Germany.) July 29th.

16,769. "An overhead trolley wire cut-out." F. Edwards. July 30th.

16,801. "A self-restoring intercommunication telephone." G. H. Freeman and B. Pearce. July 30th.

16,814. "Electric installation for transmitting the time." D. Perret. July 30th. (Date applied for under Patents Act, 1901, August 11th, 1903, being date of application in Switzerland.) (Complete.)

16,815. "Armature connection for motor electricity meters." J. Geyer. July 30th. (Complete.)

16,820. "Electric winding-up device, for clocks and other chronometrical instruments with or without clockwork." J. B. J. Sallin. July 30th. (Complete.)

16,887. "Improvements in connections for electric conductors, more especially intended for use with 'earthed' pipes or pipes for protecting electrical conductors." J. Y. Johnson. (Hartmann & Braun Aktien-Gesellschaft, Germany.) July 30th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

Electric Switches and Fuses and Boxes for the same. Callender's Cable and Construction Co., Ltd., and Ward. 11,554.

Electrical Power Factor Indicators. E. A. Carolan. (The General Electric Co., United States.) 11,726. May 22nd.

Improvements in Electric Switches. E. A. Carolan. (The General Electric Co., United States.) 11,728. May 22nd.

Means for Electrically Igniting Miners' Lamps. W. Best. 11,894. May 25th.

Brushes for Dynamo-Electric Machines or the like. H. H. Lake. (Soc. Anon. le Carbone.) 12,409. May 30th.